DE LA RUPTURE

OU DE

L'ÉCRASEMENT SOUS-CUTANÉ DES TUMEURS

EN GÉNÉRAL,

DES TUMEURS SANGUINES, EN PARTICULIER;

PAR

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Les chirurgiens ont assez entendu parler, depuis quelques années, des *ponctions*, des *incisions* sous-cutanées pour n'être point surpris qu'on songe aujourd'hui aux ruptures, aux écrasemens de certaines tumeurs placées sous la peau. L'innocuité des blessures *cachées*, à l'abri du contact de l'atmosphère ou non *exposées*, si bien établie déjà par Hunter et par l'école de Montpellier, a pris de nos jours un tel degré d'évidence par le fait de la ténotomie qu'elle est maintenant à l'abri de toute contestation. (1)

Le remède sur lequel je veux appeler ici l'attention, et qui appartient à la catégorie des divisions de tissus *non exposée* est d'ailleurs un remède déjà ancien. Il consiste dans la déchirure de tumeurs, des parois de certaines cavités remplies

(1) Voyez Vidal, *Annales de la Chirurgie*, t. VI, p. 448; t. VII, p. 32.

de liquide, déchirure qui doit être opérée sans altérer la continuité des tégumens. De ce que ce moyen est originairement un remède de bonne femme, un remède sorti du hasard, on aurait tort de l'accueillir avec répugnance ; j'espère montrer qu'il doit prendre rang en chirurgie, à côté des opérations les plus simples, les plus innocentes et les plus constamment efficaces.

En général, les chirurgiens repoussent avec trop de dédain les remèdes vulgairement appelés remèdes de commère ou de bonne-femme. On oublie trop que nombre de ces moyens, de ces remèdes populaires sont en réalité des ressources importantes. S'ils n'avaient aucune valeur, la tradition ne les passerait pas de famille en famille pendant des siècles. Le moyen d'en tirer parti consiste à ne les employer que pour les maladies ou les cas auxquels ils conviennent, au lieu de s'en servir à tort et à travers comme le font nécessairement les personnes étrangères à la médecine. Qui peut nier, après tout, que le hasard, un accident, aient plus d'une fois donné des indications précieuses à la chirurgie? Un homme affecté d'empyème ou d'hydro-thorax reçoit un coup d'épée dans la poitrine qui l'eût tué sans sa maladie, dit la fable, et qui le guérit comme par miracle. Un ascitique tombant sur un morceau de verre, se vide le péritoine, et de là l'idée de la paracenthèse dans l'hydropisie; une autre fois, c'est un homme affecté de cataracte qui se fend la cornée en tombant sur la pointe d'un instrument tranchant et qui recouvre ainsi la lumière. Qu'y a-t-il d'incroyable, d'invraisemblable dans ces histoires? Admettez qu'une personne affectée d'un ganglion, d'un nodus de la main, reçoive un coup violent sur la région malade, et la possibilité d'une rupture, d'une disparition subite de la tu-

meur apparaîtra tout aussitôt à l'esprit; que l'on fasse une chute sur la même partie, et l'on pourra évidemment se relever guéri. En faut-il davantage pour donner à la chirurgie l'idée de produire à dessein ce qui est arrivé par accident? Ce que je dis du ganglion ou du nodus s'applique également, on le conçoit, à d'autres tumeurs, aux tumeurs sanguines principalement.

La bonne philosophie veut donc que le chirurgien accepte les moyens qui viennent de gens étrangers à l'art de guérir ou que le hasard semble avoir indiqué le premier, comme s'ils étaient le fruit du raisonnement, des plus belles combinaisons intellectuelles, à la condition que l'expérience, que l'observation attentive des faits auront permis d'en constater l'efficacité et l'innocuité.

Article Ier — Écrasement des tumeurs sanguines.

Tout le monde sait, les malades comme les médecins, que les kystes synoviaux, ceux qui se développent sur la région dorsale du poignet, entre autres, sont journellement attaqués et quelquefois guéris par une pression brusque assez forte pour en rompre les parois. Quelques chirurgiens ont essayé d'écraser de la même façon certains ganglions lymphatiques dégénérés ou engorgés. J'ajouterai que les polypes de l'utérus ou de l'urèthre, que les amygdales et quelques autres tumeurs faisant relief dans certaines cavités muqueuses ou à la surface de la peau, sont aussi susceptibles d'être attaquées par l'écrasement; mais comme on écrase alors l'enveloppe tégumentaire du corps morbide en même temps que la production pathologique, ce n'est pas le lieu d'en parler ici. Quant aux tumeurs sanguines à traiter par l'écrasement, je ne veux m'occuper, pour le moment, que de celles qui sont consti-

tuées par un épanchement de sang, soit liquide, soit concret, soit pur, soit mêlé à de la sérosité, sans dégénérescence maligne.

On voit qu'il est seulement question de la sorte des collections appelées *dépôts sanguins*. La rupture ou l'écrasement de ces tumeurs est un remède dont j'avais déjà dit un mot en 1833, dans mon travail sur les contusions, et qui avait alors été mis en usage un certain nombre de fois par M. Champion, de Bar-le-Duc. J'en ai retiré depuis des résultats si satisfaisans que je crois rendre service aux malades et aux praticiens en indiquant les succès qu'il m'a procurés. On guérit avec lui instantanément des tumeurs du volume d'une noisette, d'une noix, d'un œuf, du poing même. Je dis que les guérisons obtenues ainsi sont instantanées, car l'opération ne laisse point de plaie à sa suite et n'entraîne pas non plus d'inflammation. Une fois la poche qui contenait le liquide rompue, ses parois reprennent leurs rapports primitifs, et le malade, qui n'éprouve plus de douleur au bout de quelques minutes, n'a rigoureusement besoin ni de rester immobile, ni de pansement d'aucune sorte. Le travail de résorption, de recollement des parties s'opérant sous la peau, à l'abri du contact de l'air, s'effectue sans occasionner de réaction et, pour ainsi dire, à l'insu de l'organisme. Au demeurant, je ne connais rien en chirurgie d'aussi formellement, d'aussi promptement efficace, d'aussi complétement innocent, en fait d'opérations, que la rupture sous-cutanée des tumeurs sanguines.

§ 1er *Manuel opératoire.*

Pour effectuer cette opération, on place la partie, le membre, si c'en est un, sur un plan solide. Le chirurgien ap-

plique ensuite, soit l'éminence thénar, soit le pouce, sur un des points de la circonférence du kyste; il pèse alors de toute sa force et d'une manière brusque sur la tumeur, de telle sorte que le mouvement se transmette latéralement, plutôt encore que perpendiculairement. Souvent il est utile d'appliquer ainsi les deux mains ou les deux pouces l'un sur l'autre. Quand, en pressant comme je viens de le dire, on n'a pas réussi, il convient d'appliquer les éminences thénar en plein sur la tumeur et de la presser directement ou perpendiculairement. Si une pression continue et régulière échoue, on en vient à une pression par saccade, par secousse; on peut aussi, ayant appliqué une plaque de bois blanc ou de tout autre corps solide sur le kyste, opérer l'écrasement d'un coup de poing ou par l'intermède d'un maillet.

Quand le kyste cède, on s'en aperçoit aussitôt à la disparition de la tumeur et à la production immédiate de quelques bosselures dans le voisinage. Ces bosselures étant dues à la diffusion des matières qui se sont échappées dans les mailles du tissu cellulaire voisin, doivent d'ailleurs être disséminées, écrasées à leur tour, réduites en parcelles ou en petits fragmens par de nouvelles pressions. Autrement il serait possible qu'alors elles devinssent à leur tour de petits dépôts sanguins qui nécessiteraient plus tard un écrasement nouveau ou quelque autre médication.

Le foyer ayant été bien vidé par les pressions et les glissemens répétés du pouce, pourrait à la rigueur être abandonné à lui-même, mais comme ses parois pourraient aussi exhaler ou du sérum ou un liquide sanguinolent, et donner ainsi naissance à une nouvelle collection, il est plus prudent de poser sur la région antérieurement occupée par la tumeur,

quelques compresses graduées imbibées d'un liquide résolutif et un bandage modérément compressif.

Si la tumeur occupe toute autre région que les membres inférieurs, le malade n'est nullement obligé de garder le lit ni la chambre, de rester en repos; rien ne l'empêche de vaquer à ses occupations habituelles, pourvu qu'il évite de fatiguer la région malade le jour même de l'opération. Aux pieds, aux jambes, aux cuisses, si le bandage n'est pas susceptible de se déplacer, le repos au lit n'est pas non plus indispensable. Les petits soins que la prudence peut indiquer en pareil cas, ne sont du moins exigibles que pendant un jour ou deux.

J'ai maintenant guéri, en me comportant de la sorte, une infinité de tumeurs sanguines, de date et de volume très différens. En voici deux exemples encore tout récens, qui se sont passés le même jour à l'hôpital de la Charité. Un homme adulte, bien constitué, travaillant sur les ports, est renversé par une voiture, dont une des roues lui passe sur la jambe gauche. Porté immédiatement à l'hôpital, cet homme présente, au moment de la visite, le lendemain, un gonflement livide, ecchymotique, qui s'étend depuis le pied jusqu'au genou et qui comprend toute la circonférence en même temps que toute l'épaisseur de la jambe. Presque partout le sang épanché occupe les tissus à l'état d'infiltration. Il ne se trouve sous forme de collection, qu'un peu au-dessous du milieu de la jambe au niveau de la crête du tibia, où il constitue une tumeur large comme la paume de la main.

Une saignée, des linges imbibés d'une solution aqueuse de chlorhydrate d'ammoniaque, la compression au moyen d'un bandage roulé et une alimentation légère aidée d'un repos absolu, dissipent le gonflement et l'infiltration dans l'espace

de dix à onze jours; après s'être rapidement resserrée en proéminant davantage, la collection reste fixe au contraire, et ne perd plus rien de son volume à partir du sixième jour. Nulle inflammation, nulle douleur ne s'étant manifestées, la peau conservant toute sa vitalité, je procède à l'écrasement le dix-septième jour. Pendant que les doigts de mes deux mains embrassent le côté péronier de la jambe, je presse de mes deux pouces le kyste sanguin de dedans en dehors, c'est-à-dire en agissant de la face interne du tibia vers la crête de cet os, et comme pour chasser le liquide sur la face antérieure des muscles extenseurs des orteils. Après quelques secondes d'efforts, je sens que la tumeur cède, fuit et diparaît; j'en poursuis, j'en étale les grumeaux à quelques centimètres tout autour; une sorte de dépression, de cupule entourée d'un relief dur, d'une bordure légèrement inégale, se sent à la place de la tumeur. Le malade qui croyait à une plaisanterie pendant l'opération, n'a d'ailleurs éprouvé qu'une faible douleur, et paraît tout surpris de ne plus voir sa tumeur. Je fais appliquer une compresse graduée sur la région malade; le bandage compressif est reposé par dessus; le lendemain, on ne distingue plus avec les doigts le lieu qu'occupait la collection des autres régions du membre. Cette tumeur, prise au moment de l'écrasement, avait encore le volume d'un œuf de poule.

A deux lits plus loin, était un ouvrier anglais employé au chemin de fer de Versailles (rive gauche), et dont la jambe droite avait été prise, violemment froissée entre deux wagons. Cet homme, dont le péroné était brisé au niveau de la partie inférieure du mollet et qui avait une infiltration sanguine considérable de toute la longueur du membre, présentait de plus un dépôt de sang du volume d'une grosse noix,

parfaitement circonscrit, globuleux sur la face interne du tibia, immédiatement au-dessus de la malléole correspondante. Après avoir attendu une semaine l'amoindrissement de cette collection, après m'être assuré que les topiques résolutifs qui avaient dissipé l'infiltration restaient sans effet contre ce petit dépôt, désirant au surplus pouvoir appliquer le bandage nécessité par la fracture, je procédai le huitième jour à la rupture sous-cutanée du kyste sanguin. Je m'y pris à-peu-près comme dans le cas précédent. Prenant un point d'appui avec les doigts de la main gauche sur le bord externe du pied, et avec les doigts de la main droite sur la malléole externe, j'embrassai solidement la moitié inférieure et postérieure de la tumeur au moyen des deux pouces, qui, en la refoulant de toutes mes forces vers la fosse inter-osseuse antérieure, la déchirèrent bientôt au point de la faire disparaître brusquement.

Rien de spécial ne fut maintenu sur le point préalablement occupé par la collection, et le lendemain il n'y avait plus trace de tumeur sanguine dans cet endroit.

Ce que je viens de dire de l'écrasement des tumeurs sanguines chez ces deux malades, je l'ai observé chez une foule d'autres, chez les femmes comme chez les hommes, aux bras comme aux jambes, sur le tronc comme sur les membres ; à l'occasion de tumeurs datant de huit jours et dans des cas où la maladie durait déjà depuis un mois à six semaines.

§ 2. *Efficacité comparative.*

Pour se faire une idée des avantages de l'écrasement en pareil cas, il ne faut point perdre de vue que les dépôts sanguins une fois bien établis, qui ne cèdent point aux traitemens résolutifs dans la première quinzaine de leur formation,

disparaissent rarement par résolution. Quand même, au surplus, la résolution devrait en triompher, toujours est-il que c'est, en général, au prix d'un laps de temps assez considérable et de soins continus. L'écrasement n'ayant rien qui puisse effrayer les malades, ne produisant point de plaie, n'exposant à aucun inconvénient, mériterait donc encore la préférence sur les topiques résolutifs, puisqu'il réussit instantanément et redonne la liberté aux blessés au bout de quelques minutes.

A. *Injections.* — En supposant que les résolutifs soient impuissans, il n'y a plus guère de guérison possible, sans l'écrasement, qu'au moyen de l'instrument tranchant. Si la collection était franchement fluide, peut-être en triompherait-on, ainsi que je l'ai fait quelquefois, par la ponction et l'injection iodée comme d'une hydrocèle : mais qui ne voit que, malgré sa simplicité, son innocuité bien connue, cette opération est encore infiniment plus sérieuse que la rupture ou l'écrasement du kyste? Pour beaucoup de malades, en effet, la simple ponction avec le trois-quarts est déjà un remède qu'ils n'acceptent pas volontiers; puis, sans parler d'un peu de douleur, de la réaction inflammatoire que l'injection provoque, n'a-t-on pas alors une nouvelle tumeur, une nouvelle collection, qui met ensuite de dix à vingt ou trente jours pour disparaître définitivement. Il suffit donc d'y songer un moment pour voir que l'écrasement est de beaucoup préférable aux injections irritantes que les collections sanguines sont d'ailleurs loin d'admettre généralement.

B. Une autre opération également peu grave, applicable aux tumeurs sanguines, est l'*incision sous-cutanée*. Un fer de lance bien tranchant porté sous la peau dans ces tumeurs, et qui en divise les parois plus ou moins largement, permet de

les vider sur-le-champ ou d'en infiltrer le liquide dans les tissus voisins.

On obtient ainsi les mêmes résultats que par l'écrasement proprement dit ; mais il saute aux yeux que l'instrument tranchant, qui cause toujours plus ou moins de douleur et une certaine frayeur au malade, est là en plus que dans la rupture sous-cutanée simple ; ajoutons qu'à cause de la petite plaie des tégumens qu'il faut empêcher de suppurer, on doit astreindre le malade pendant quelques jours à de certains ménagemens, à de certaines précautions tout-à-fait inutiles quand il s'agit de l'écrasement proprement dit. Il est évident, au surplus, que l'incision sous-cutanée ne l'emporte en rien pour l'efficacité sur l'écrasement pur et simple.

C. Reste enfin l'*incision* de la tumeur à la manière d'un abcès. Cette incision, il ne faut pas se le dissimuler, n'est point sans quelque gravité. A moins qu'on n'en réunisse les lèvres après avoir vidé le kyste, pour en obtenir l'agglutination immédiate, elle est ordinairement le point de départ d'une inflammation purulente de tout le foyer sanguin. On a dès-lors à craindre une réaction parfois très vive, une phlegmasie qui peut devenir diffuse, se compliquer d'érysipèle, d'angéioleucite, de phlébite, de phlegmon diffus, comme je l'ai vu chez quelques malades et comme les exemples n'en sont pas rares. On peut être sûr au moins que le kyste ainsi transformé en abcès suppurera un certain temps, aura besoin de se modifier, de se déterger avant de pouvoir se cicatriser. Si donc, par ce traitement, le malade peut sortir du lit ou de la chambre au bout de quinze ou vingt jours, c'est le mieux qu'il soit possible d'espérer. J'imagine, d'après cela, que personne ne sera tenté d'en venir à l'incision ou aux incisions des dépôts de sang si l'écrasement leur est applicable.

§ 3. *Conditions nécessaires au succès.*

Par malheur, la rupture sous-cutanée des tumeurs sanguines n'est pas toujours proposable; c'est un remède qui exige un certain nombre de conditions matérielles pour être véritablement utile.

A. *Siége.* — D'abord il est à-peu-près impossible de l'appliquer aux tumeurs sous-aponévrotiques. Il faut aussi que les tissus qui entourent, qui avoisinent le kyste ne soient que d'une médiocre densité. Plus ils sont souples et lamelleux, plus l'écrasement est facile et sûr. En effet, si la collection de sang s'est établie entre des couches filamenteuses, serrées, très résistantes, il sera nécessairement très difficile d'en rompre les enveloppes, de l'expulser, de la disséminer aux environs. De plus, il est utile que le sang épanché repose sur un plan résistant, assez fixe: sans cela, la pression exercée sur la peau irait se perdre dans l'autre paroi souple du sac et ne briserait rien. Les régions où cette opération est le plus aisée, sont donc le dos des pieds et des mains, toute l'étendue des membres, par la raison que là, l'aponévrose ou les os servent de point d'appui au kyste, qu'une puissance externe presse par la surface de la peau. Le devant du sternum est encore très favorable à l'écrasement. Les parois du ventre sont trop flexibles, au contraire, pour rendre cette opération aisée. La mollesse des tissus est trop grande à la fesse pour permettre dans cette région un pareil remède. Toute la région dorsale du tronc est doublée de tissus trop serrés trop filamenteux pour que l'écrasement des tumeurs sanguines y soit aussi facile qu'aux membres. Des raisons d'un autre ordre, et que chacun devine, empêchent aussi de l'appliquer fructueusement sur les côtés et au-devant du cou. Sur

les pommettes, les tempes, la région massétérine, le front et la voûte du crâne, on peut y recourir avec avantage, tandis que dans l'épaisseur des joues ou des lèvres, la rupture des dépôts de sang est généralement fort difficile.

B. *Volume.* — On conçoit en outre qu'au-delà d'un certain volume, qu'au-delà du volume du poing, par exemple, les collections de sang doivent être très difficiles à rompre, il s'ensuit naturellement qu'on ne doit guère songer à ce remède que pour des tumeurs de dimension médiocre ou petite.

Pour que l'écrasement des tumeurs sanguines soit facile, il faut encore que les parois du kyste n'aient pas eu le temps de revêtir une grande solidité. Si la maladie date de plusieurs mois, les couches celluleuses qui entourent le dépôt auront eu le temps de s'adosser les unes aux autres, de se confondre entre elles, d'acquérir une grande force de cohésion et de se mettre en mesure, par conséquent, de résister à de violentes pressions extérieures. Sous ce point de vue il faut même distinguer deux genres de collection de sang : les collections dans les cavités naturelles et les collections entre les lames du tissu cellulaire.

C. *Cavités naturelles.* — Dans les cavités séreuses, dans les cavités sous-cutanées, dites bourses muqueuses, par exemple, les dépôts de sang sont notablement plus difficiles à écraser que dans les cavités accidentelles.

La bourse muqueuse, organisée, déjà douée d'une grande densité depuis long-temps, présente parfois une résistance telle, qu'il n'y a pas moyen de la rompre. C'est dans des cas pareils, qu'on est parfois forcé d'associer l'incision sous-cutanée à l'écrasement. J'ajoute qu'après avoir vidé, débarrassé ces cavités naturelles du sang qu'elles contenaient, il y a moins de chance d'en voir recoller immédiatement les

parois que s'il s'agissait d'un dépôt dans une cavité accidentelle. Toutes choses égales d'ailleurs donc, les cavités naturelles remplies de sang se prêtent moins bien que les cavités accidentelles à la rupture, à l'écrasement sous-cutané.

D'. *Cavités accidentelles.*—Lorsque le sang s'épanche entre les lames du tissu cellulaire et qu'il s'y rassemble en collection, c'est en établissant là, accidentellement une sorte de cavité close; mais on conçoit que les parois de cette cavité seront long-temps faciles à rompre, à déchirer, puisqu'elles se continuent sans organisation spéciale avec le tissu cellulaire qui les avoisine. Si, plus tard, quand la tumeur est ancienne, l'écrasement devient difficile, c'est précisément parce que, à la longue, la cavité accidentelle revêt en grande partie la densité, les propriétés des cavités normales.

§ 4. *But de l'écrasement.*

Pour se faire une idée nette de l'efficacité de l'écrasement des tumeurs sanguines, il n'y a qu'à se rappeler la marche naturelle des infiltrations, comparées à celles des dépôts de sang proprement dits.

A. L'observation journalière démontre qu'à la suite des contusions, les *infiltrations* sanguines, les ecchymoses de toutes sortes, quels qu'en soient l'étendue et le siége, disparaissent spontanément ou sous l'influence de médications les plus simples dans l'espace de quelques semaines. S'il n'y a point de déchirure, aucune fracture, si les tissus n'ont pas été largement broyés, si, par elle-même, la blessure, cause de l'infiltration ou des ecchymoses, n'est pas de nature à faire naître des accidens, il est presque sans exemple que l'infiltration sanguine soit devenue une maladie sérieuse. Imbibées de sang sous la peau, sous les aponévroses ou entre

les muscles, les mailles, les lamelles celluleuses l'absorbent, le transmettent aux différens systèmes vasculaires, et ce liquide ne tarde pas à disparaître d'une manière quelconque des régions où il s'était d'abord épanché. C'est là un fait à l'abri de toute espèce de contestation, que tous les chirurgiens observent chaque jour, et qui est à la connaissance des gens étrangers à la médecine comme des praticiens les plus répandus.

B. Si, au lieu de s'infiltrer dans le tissu cellulaire comme dans une éponge, le sang s'est amassé sous forme de collection entre les lames de la couche sous-cutanée, il se peut encore que l'absorption s'en opère; beaucoup de tumeurs sanguines guérissent ainsi par résolution dans l'espace de trois ou quatre semaines, à-peu-près comme s'il n'y avait eu qu'une simple infiltration : c'est que, si aucun travail adhésif ne s'établit autour de la collection, si le sang ne se *mortifie* pas de manière à imbiber, à encroûter comme d'une matière inerte l'enveloppe immédiate du foyer, le tissu cellulaire voisin l'attire de proche en proche et s'en imbibe à la manière d'une étoffe pour en débarrasser la région malade.

C. La nature, dans ce cas, semble avoir pour but d'établir elle-même l'infiltration aux dépens de la collection, tant il est vrai que pour disparaître des régions où il s'est épanché, le sang est obligé de se servir du tissu cellulaire comme d'un véritable filtre. Mais, il arrive souvent que les parois du foyer mettent un obstacle à ce travail réparateur, qu'elles se durcissent, que d'une manière ou d'une autre elles cessent d'être perméables, qu'elles ne se prêtent plus enfin au phénomène connu sous le nom d'exosmose. Alors la tumeur peut se maintenir indéfiniment, et la matière épanchée y subir des transformations variées.

D. Ce qui arrive dans les foyers sanguins brusquement établis au sein du tissu cellulaire s'observe beaucoup plus souvent encore dans les collections hématiques des cavités closes naturelles ; aussi rien n'est-il plus commun que de voir les épanchemens de sang de la tunique vaginale, des bourses muqueuses sous-cutanées ou tendineuses, persister indéfiniment, résister à toutes les médications résolutives imaginables. Ces cavités, en effet, ne tardent pas à perdre le poli, la régularité de leur surface, à s'imbiber en quelque sorte d'une couche de sang friable, d'aspect pulvérulent qui en détruit les porosités, qui en rend pour ainsi dire les parois inertes ; si donc la collection de sang établie dans une cavité close, normale ou accidentelle, n'en disparaît pas avant que les parois de ces cavités aient perdu leur perméabilité, c'est-à-dire dans l'espace de quinze jours ou un mois, la guérison du mal par résolution, soit spontanée soit sous l'influence des topiques, n'est plus qu'une exception assez rare.

E. Ces enseignemens de l'expérience, une fois bien saisis, ne conduisent-ils pas à l'indication du remède dont je cherche à faire ressortir la valeur en ce moment? Puisque, infiltré dans le tissu cellulaire, le sang disparaît toujours sans faire naître d'accidens, tandis qu'accumulé en dépôt sous forme de collection, il tend sans cesse à s'y maintenir, à constituer une maladie de plus en plus rebelle, n'est-il pas évident que le chirurgien doit songer à transformer la collection en infiltration sanguine? Ce que j'ai dit jusqu'ici fait assez voir que cette transformation est généralement assez facile ; que les conséquences en sont parfaitement heureuses, et que la pratique justifie pleinement en cela les espérances qu'avaient indiquées les analogies.

F. Au demeurant donc, il y a plus de chance d'obtenir la ré-

solution d'un dépôt de sang dans le tissu cellulaire que dans une cavité close naturelle ; mais cette résolution est à-peu-près certaine toutes les fois que le sang est épanché, infiltré dans les mailles des tissus au lieu d'être rassemblé au foyer. L'indication serait, par conséquent, de rompre les cavités normales remplies de sang pour substituer un dépôt dans une cavité accidentelle au dépôt de la cavité normale s'il n'était pas possible de lui substituer une infiltration proprement dite. En un mot, le but réel du praticien en pareil cas saute à tous les yeux : c'est qu'il est indiqué quand la chose paraît possible de réduire les collections sanguines, suite de coup, de violence extérieure, à l'état de pure infiltration, afin que l'organisme reprenne librement le sang qui lui était échappé au moment de l'accident.

§ 5. *Contre-indications.*

Pour que l'écrasement des tumeurs hématiques jouisse de l'efficacité que je lui attribue, il faut que la peau ne soit pas désorganisée, que la tumeur ne soit le siége d'aucune inflammation.

A. S'il existait une *eschare*, quelque étroite qu'elle fût, sur un des points de la tumeur, ainsi que cela s'observe si fréquemment dans les contusions, l'écrasement, au lieu d'être utile, pourrait aggraver notablement le mal. Ces sortes d'eschares, qui se comportent à-peu-près comme celles de la brûlure, avec cette différence seulement que l'élimination en est généralement moins rapide, exposent à deux inconvéniens : 1° elles sont une cause incessante de phlegmasie, d'érysipèle, de suppuration ; 2° en se détachant si elles sont épaisses, elles peuvent mettre le

foyer morbide en contact avec l'atmosphère. Or, on ne doit point oublier que la résolution des tumeurs hématiques traitées par l'écrasement ne s'obtient qu'à une condition : c'est qu'il ne s'établira sous la peau aucune apparence d'inflammation purulente. Toutefois, si l'eschare ne comprenait pas toute l'épaisseur des parois du foyer, si elle n'était encore entourée que d'un liseret inflammatoire très-restreint, si le reste de la tumeur se maintenait indolent, ne présentait pas de signe manifeste d'inflammation, ce ne serait pas une raison pour s'abstenir de l'écrasement. Il en serait de même encore à la rigueur quand l'eschare pénètre jusque dans la collection, pourvu qu'elle se continue très solidement par tous les points de sa circonférence avec les tissus vivans, et qu'aucun travail phlegmasique n'ait été remarqué dans la cavité de la collection.

En procédant à l'écrasement malgré ces complications, voici ce qui est possible : une fois la cavité vidée, il ne lui faut que de deux à cinq ou six jours pour disparaître. Ses parois se confondent, dans ce court espace de temps, l'une avec l'autre, ou se perdent dans le tissu cellulaire normal. Si l'eschare est superficielle, elle subit dès-lors toutes les phases naturelles à ce genre de maladie, comme s'il n'y avait point eu de collection hématique au-dessous. Si elle était profonde, il est à espérer qu'au moment où l'inflammation la détachera des tissus vivans, les parois de la cavité morbide seront assez bien recollées pour qu'il n'y ait plus à en craindre la suppuration.

On le voit, le succès de l'écrasement ici tient à ce qu'il n'y a plus de cavité sanguine au moment où une inflammation purulente, occasionnée par le travail éliminateur de l'eschare, vient à s'établir. On devine en même temps que

les chances de succès sont moindres pour les tumeurs hématiques des cavités normales que pour les collections des cavités accidentelles; la persistance des cavités normales après leur rupture, après qu'elles ont été débarrassées de la collection qui s'y était formée, est cause de cette différence. Il en résulte effectivement que l'inflammation de l'ulcère amené par l'eschare peut toujours envahir l'intérieur de ces cavités et y devenir purulente, tandis qu'au bout d'un certain temps cet accident n'est plus possible dans la région occupée par les tumeurs accidentelles.

B. Que la tumeur hématique s'échauffe, *s'enflamme* à cause des eschares, ou des excoriations, des froissemens qu'elle a éprouvés ou qu'elle présente à sa surface, peu importe, eu égard à l'écrasement. Si cette inflammation date déjà de quelques jours, approche de l'état aigu, elle nuit sous deux points de vue: 1° elle a déjà modifié, dénaturé le sang épanché qui se transforme bientôt en une matière hétérogène, dont l'absorption ne se fait plus, ou ne se fait que très difficilement; 2° cette inflammation continuant après la rupture du kyste, amène promptement dans cette cavité une exhalation abondante d'un liquide formé de pus, de sérum et de détritus sanguins. On a dès-lors un dépôt purulent à la place d'une tumeur hématique, et souvent un dépôt qui se complique d'érysipèle phlegmoneux, au lieu d'une collection transformée en infiltration hématique. J'ai vu ces complications sur trois des malades de ma division à la Charité, comme j'ai vu, d'un autre côté, cinq ou six fois l'écrasement réussir complétement et rapidement, malgré la présence d'excoriations ou d'eschares, d'un commencement d'inflammation à la surface, et dans l'épaisseur des parois de la tumeur.

Art. II. — Autres tumeurs.

Ce qui précède laisse déjà entrevoir que, pour offrir des chances raisonnables de succès, l'écrasement des tumeurs exige une première condition essentielle : c'est que la matière qu'il permet de disséminer dans le tissu cellulaire soit assimilable. Partant de ce principe, on s'aperçoit aussitôt que cette opération ne convient point à un nombre considérable de tumeurs. Une fois broyée ou infiltrée, la matière qu'on a déplacée doit en effet disparaître sous l'influence de l'absorption. S'il en restait quelques grumeaux, quelques parcelles qui pussent faire corps étranger, on courrait risque de voir s'établir là un nouvel épanchement ou une autre espèce de tumeur. Il s'ensuit que toutes les productions hétérogènes, que les squirrhes, les encéphaloïdes, la mélanose, les masses colloïdes, le pus, l'urine, les matières intestinales, etc., donneraient lieu à des accidens pour le moins aussi graves que la maladie première, si on venait à rompre par l'écrasement les cavités où elles se trouvent contenues. Écrasez un abcès, et vous aurez, selon toute apparence, un phlegmon diffus, à la place d'une simple collection purulente; il en serait de même d'une collection urinaire, d'un foyer de matières intestinales. Personne n'aura sans doute la pensée qu'une tumeur cancéreuse écrasée sous la peau pourrait disparaître par absorption, et ne pas se reproduire dans le même lieu avec plus d'intensité qu'auparavant.

Ainsi, c'est aux seules tumeurs formées de matières ou de tissus homogènes, *analogues*, assimilables, ayant leurs semblables dans l'économie normale, que l'écrasement peut être utilement appliqué. Les tumeurs synoviales, les kystes séreux de toutes sortes, les lipômes, les ganglions lymphati-

ques hypertrophiés, peut-être aussi certaines variétés de stéatômes pourront y être soumis.

§ 1er. *Kystes séreux ou synoviaux.*

Chose étrange! le kyste synovial auquel l'écrasement est journellement appliqué depuis plusieurs siècles, en quelque sorte la seule variété de tumeur qui ait été attaquée jusqu'à présent par l'écrasement, est précisément celle qui s'en trouve le moins bien. Effectivement, la rupture d'un kyste synovial, en faisant disparaître la tumeur, n'empêche point la cavité où la collection s'était établie de persister. Les parois de semblables kystes ne se recollent que difficilement, ne se recollent guère que sous l'influence d'une phlegmasie adhésive. Aussi se laissent-elles bientôt écarter de nouveau par le liquide qui continue de s'en exhaler, et la tumeur manque-t-elle rarement de reparaître au bout de quelques semaines ou de quelques mois chez les malades ainsi traités. La récidive est donc la règle et la guérison l'exception assez rare, quand on traite les ganglions, les kystes synoviaux par l'écrasement, à moins qu'on n'y associe la compression, le vésicatoire volant ou certains résolutifs, pendant au moins quinze jours.

§ 2. *Kystes purement séreux.*

Les kystes purement séreux sont à-peu-près dans le même cas. Cependant, comme leurs parois sont généralement plus souples, plus vasculaires, elles se récollent plus souvent que celles des kystes synoviaux quand on en a expulsé par l'écrasement le liquide épanché. Aucun chirurgien n'ignore néanmoins la rareté des guérisons radicales de l'hydrocèle, par exemple, traitée par la simple ponction, par l'écrasement du kyste ou même par les incisions sous-

cutanées. J'ai rassemblé ailleurs (*Méd. opé.*, etc.), et depuis, plus de vingt exemples d'hydrocèles écrasées, sans avoir trouvé un seul cas bien authentique où la maladie, ainsi détruite momentanément, ne soit pas revenue. En 1839 et 1840, j'ai traité sept hydrocèles par les incisions sous-cutanées, et chez les sept malades, l'hydrocèle s'est rétablie entre la troisième semaine et le troisième mois. On doit donc très peu compter sur l'efficacité de l'écrasement, je le répète, dans les kystes séreux ou synoviaux.

§ 3. *Le mélicéris.*

Le mélicéris est tout-à-fait réfractaire à ce genre d'opération. Le kyste contient alors une matière qui n'est pas susceptible d'être absorbée et qui se reproduit sans cesse, tant que ses parois n'ont pas été détruites ou profondément modifiées.

§ 4. *Le stéatôme.*

Le stéatôme, dont tant de personnes présentent des exemples nombreux sur le crâne, cède quelquefois à l'écrasement parce que, à l'état de simplicité, la matière qui le constitue, une fois éparpillée autour du foyer, peut disparaître insensiblement par absorption moléculaire. Il est vrai cependant que si la tumeur dépasse le volume d'une grosse aveline, si elle a déjà subi quelques transformations, la matière infiltrée agira le plus souvent comme corps étrangers, fera naître de la suppuration, exposera à l'érysipèle, et pourra faire regretter d'avoir appliqué l'écrasement au stéatôme. J'ai vu les deux choses chez des malades différens, et qui s'étaient écrasées des tumeurs de la tête en se heurtant contre des corps durs involontairement.

Les tumeurs *graisseuses* disparaîtraient probablement

par l'écrasement s'il était possible de le leur appliquer ; mais on conçoit qu'à l'exception d'un très petit nombre d'entre elles, ce n'est pas une opération proposable ni exécutable.

Les ganglions lymphatiques hypertrophiés, dégénérés, étant un peu plus friables, se prêteraient notablement mieux à des tentatives de ce genre. J'en ai traité quelques-uns par écrasement autour de la mâchoire inférieure, au-dessus du coude et dans l'aine. La guérison n'en est résultée toutefois que chez le plus petit nombre des malades, et je doute qu'elle soit possible, quand au lieu d'une simple hypertrophie, phlegmasique ou non, la tumeur ganglionnaire contient de la matière tuberculeuse ou purulente infiltrée.

From the Author

ON

TRACHEOTOMY,

ESPECIALLY IN RELATION TO

DISEASES OF THE LARYNX AND TRACHEA.

ROYAL COLLEGE OF SURGEONS OF ENGLAND

BY

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ON

TRACHEOTOMY

ESPECIALLY IN RELATION TO

DISEASES OF THE LARYNX AND TRACHEA.

I.—Introduction.

The operations which are adopted for the purpose of opening the windpipe include Laryngotomy, Laryngo-tracheotomy, and Tracheotomy. Laryngotomy signifies division of the crico-thyroid membrane, and it is a remarkably easy operation, owing to the superficial position of the membrane, and from there being but one vessel of any consequence which comes in the way, namely, the crico-thyroid, a small branch of the superior thyroid artery. Though laryngotomy commends itself by the simplicity and case of its performance, the tube is particularly liable, after it has been worn for some time, to cause necrosis of the laryngeal cartilages; and coming into such close contact with the vocal organs, vocalization is likely to be permanently impaired. For these reasons it is an undesirable operation, unless some very special requirement demands its adoption. In Laryngo-tracheotomy the cricoid cartilage is cut through along with the first ring of the trachea. This operation may also be considered inexpedient, on account of the danger of the canula setting up disease of the cricoid cartilage, and also because by dividing this ring the strength of the laryngeal canal is materially diminished. In very few cases is it desirable to operate in this manner, but it may be necessary in consequence

of the extreme shortness of the windpipe. Tracheotomy constitutes the operation of opening the windpipe by an incision through the tracheal rings, and will be the only operation further referred to in this work. By the insertion of the canula below the cricoid cartilage, all risk of suffocation from any disease of the larynx is obviated; and, furthermore, the operator is better enabled in this situation to cope with any obstruction that may exist in the trachea. In the course of my remarks it may be deemed desirable to allude to other modes of treatment applicable to some of the more important diseases, with the view of obviating the necessity of having recourse to tracheotomy.

Until within the last quarter of a century no surgeon was able accurately to ascertain the cause of dyspnœa for which he was called upon to open the windpipe, and tracheotomy was performed as a *dernier ressort,* when the breathing of the patient had become so impeded that suffocation was imminent. Since the laryngoscope has come into practical use, however, any condition of the larynx interfering with respiration can be recognized with certainty and precision. By means of this instrument not only can the seat, extent, and nature of the disease be determined, but also, for the most part, the constitutional condition on which it depends; and thus not only the desirability of operating, but likewise in many cases the time at which the operation should be performed, may be fixed; and, moreover, a decided opinion can be arrived at as to the future course of events. Thus, should the disease be either carcinomatous or associated with phthisis, it can be determined that tracheotomy would be undesirable, except in the instances to which reference will be made when discussing these diseases. Should the affection be either chronic laryngitis or syphilitic laryngitis, the necessity of performing tracheotomy may be recognized; and, further, it may be prognosticated that in the former disease life will be prolonged for some months, but not for a term beyond two years, and that the tracheal canula will always have to be worn; on the contrary, that in syphilitic laryngitis life may be prolonged for any natural period, and also—especially in the most recent forms of the disease, where there is no great distortion of the laryngeal structures, that after a few weeks or months it will be

possible to remove the canula. Further, although the dyspnœa in syphilitic laryngitis may be considerable, a laryngoscopic examination will in some cases show that the operation may safely be deferred for some days, in order that the effect of constitutional treatment may be tried. This course could not be adopted in chronic laryngitis, for it would be useless to delay operating when the breathing is much affected, as the stenosis must increase in spite of any treatment.

I would here state that in the performance of tracheotomy I never employ chloroform, but simply freeze the skin by means of ether spray; and for this reason, that it is of vital importance, as soon as the trachea is opened, that the patient should be able to cough up any blood which may have passed down into the air-passages. Should an anæsthetic have been given, this cannot be done, for its effects will not have passed off in time. Even in operating upon children I never employ chloroform, but have the patient wrapped up in a sheet and forcibly held down. Should there be insufficient assistance, it would be compulsory to anæsthetize a child, unless it had passed into an asphyxiated condition. The pain occasioned by cutting the skin is done away with by freezing with the spray; that accompanying division of the tissues beneath the skin is not severe, being no more than adult patients can easily bear, and will put up with if an assuring word be spoken to them whilst the operation is proceeding. Patients have often expressed to me what slight suffering they experienced in comparison with what they expected.

II.—Anatomy of the Trachea.

The portion of the trachea to be recognized in tracheotomy is that which extends from the cricoid cartilage to the upper border of the sternum. In most persons this is of a good length, but in a small proportion it is very short, so that the cricoid cartilage reaches as low down as the sternum, and in order to get a tube into the windpipe it must be divided, or, in very rare instances it is only practicable to make an opening through the crico-thyroid membrane. The depth of the trachea varies much in different individuals. In some it is thickly covered with fat, whilst in others it feels as if it were only covered with skin.

The former condition is mostly observed in children. Sometimes the upper portion of the trachea is found to quickly descend into the mediastinum, at some distance below the sternum; at other times to run, as it were, parallel with the skin passing closely underneath the upper sternal edge. The sterno-hyoid muscles, with the sterno-thyroid immediately beneath them, lie on each side of the trachea, partially overlapping it. These two pairs of muscles are joined in the middle line by fascia, and they come directly under the cervical fascia. In the portion of the neck suitable for tracheotomy, the anterior jugular veins run along the outer side of these muscles, to pass under the sterno-mastoid muscles. The isthmus of the thyroid gland crosses the trachea beneath the sterno-hyoid and sterno-thyroid muscles, opposite the second and third rings; sometimes as high as the first, at others as low as the fourth. Above the isthmus a large vein passes across, communicating with the superior thyroid veins running up from each side of it. Superficial to the isthmus a plexus of veins is formed, and below it the inferior thyroid, formed by the continuance of the superior branches, sometimes descends in two trunks, to open into the innominate vein. An anastomosing branch between the anterior jugular veins may cross the isthmus.

Only cutaneous arteries are likely to be met with in tracheotomy, but occasionally a thyroid branch (*thyroidea ima*) runs up along the trachea to the thyroid gland, derived most commonly from the innominate, occasionally from the arch of the aorta, the common carotid, the subclavian, the right internal mammary, the left vertebral, or from both vertebrals; a branch also of the superior thyroid artery may pass vertically from the crico-thyroid membrane to the isthmus of the thyroid gland, as if to join the middle thyroid artery. Normally the innominate crosses the trachea below the upper edge of the sternum, but it may pass over as high as the eighth or ninth rings. Desault records a case in which this artery was wounded in tracheotomy. In children it crosses the trachea just opposite the upper edge of the sternum. The carotid artery may cross, if it is given off by the innominate, about the level of the sixth ring. Up to the age of two years, the thymus gland may be found extending to

the lower border of the thyroid gland; but after this age it, as a rule, decreases in size, and at puberty has almost disappeared.

III.—Instruments and Apparatus.

The instruments required for the uncomplicated operation of tracheotomy would only include a scalpel, a pair of forceps, and a tracheotomy-tube complete; but as the intention of this work is to treat of all the complications which may arise during the operation, it will be convenient to mention here every instrument and form of apparatus that may be needed under various circumstances during its performance, and for the sake of method and facility of description to arrange them under the following groups.

1. Cutting; 2. Accessory; 3. Special; 4. Tubes.

The *Cutting* instruments consist of scalpels, scissors, a small saw, and bone-forceps.

The *Accessory* instruments and apparatus comprise dissecting, artery, and torsion forceps; a pair of sharp-pointed hooks; a pair of blunt-pointed pitchfork-curved retractors; a special pillow for placing under the neck; sponges, tapes, and feathers.

The *Special* apparatus include Richardson's Ether-Spray apparatus; a small Faradaic battery; and a suction-syringe.

1. *Cutting.* Scalpels of not more than an inch in length, and a sixth of an inch in width, are to be preferred, though some should be stouter in the blade than others, for use in cases where there is partial ossification of the tracheal cartilages. When the cartilaginous rings are completely ossified, very strong scissors are serviceable, or, these failing, a small, fine saw. I have used also for this purpose a kind of bone-cutting forceps, the blades of which are made almost at right angles to the handle, the lower one being pointed, so that it can be thrust in between the tracheal cartilages, and hollowed out on its upper surface, in order that the upper blade may cut down into it, thus completely severing the cartilages.

2. *Accessory.* Sharp-pointed hooks are intended for the purpose of holding up the trachea before opening it when operating upon children, as it often has a great range of up-and-down movement. Many operators employ them, but if the dissection

Fig. 1.

has been properly carried on down to the trachea, they will not be required. The pitchfork retractors serve to hold open the trachea, and are of special use in cases of the removal of a foreign body in the windpipe, or when the trachea becomes completely blocked up by secretion, as in cases of diphtheria, or during the performance of thyrotomy. The special pillow should be a foot long, with a circumference of thirteen and a half inches for an adult, twelve for young people, and nine and a half for a child. It is to be placed under the neck of the patient, thus throwing up the trachea, while, as a rule, it does not materially embarrass the respiration. This simple arrangement I have used for some time past, and have found it of the greatest service, being better adapted for making the trachea prominent than any other plan, while it prevents the head from slipping forwards during the operation, an event which will often happen if an ordinary pillow is employed. Made of linen in the form of a bag, it can be filled with bran when required; but if constructed of india-rubber, which can be distended with air, it is very much more portable.* At a private house, if not provided with one of these pillows, the kitchen rolling-pin, wrapped round with towels, according to the thickness required, admirably supplies its place. Sponges should be cut about the size of a walnut, but rather flatter. They are sold fixed on handles, for use in tracheotomy, but this is a needless and unserviceable plan. A tracheotomy tube can be fastened in with ordinary tape, but tapes made according to the woodcuts (Figs. 1 and 2) enable the tube

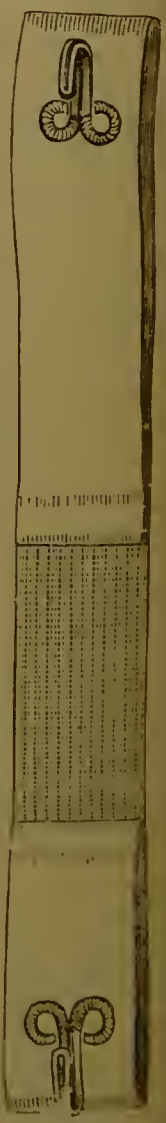

Fig. 2.

* These pillows can be obtained of Messrs. Mayer and Meltzer, of Great Portland Street.

to be fastened in without disturbing the patient; for the hooks (those in common use) at the ends can be inserted into the eyelets of the shield far more readily than ordinary tape can be drawn through, and without disturbing the position of the tube. If one is made longer than the other, it enables them to be fastened at the side of the patient, without raising him up. The longer tape is perforated at the end remote from the canula with a number of eyelet holes; the shorter one has a hook, as at the other end, to fasten into any one of these holes, so that one pair of tapes can be made to fit an adult or an infant. Each has a piece of elastic let into the centre portion, so that it yields according to the movements of the patient. These tapes can be washed. Feathers are required for the purpose of clearing out the mucus from the tube, and those derived from the wing of the common fowl are most suitable. The tip of the feather should be cut off, and the edges very slightly trimmed, leaving it rather larger than the calibre of the tube. A number of these feathers should be prepared, and, after using one, it should be cleaned and dried before being employed again, otherwise it will soon become of no service.

3. *Special.* The ether-spray apparatus is required for freezing the skin, in order to prevent the pain that would otherwise be felt in the cutaneous incision. The reason for using it in preference to chloroform has already been considered. A small battery should be always, if possible, ready on the table for immediate use in such cases as are described at page 31. The suction-syringe may be needed to withdraw blood from the bronchi when it has passed down in such quantities that the patient is unable to cough it up. It consists of an ordinary glass syringe, made with a graduated-sized nozzle, so that it can be quickly adapted to either of the four canulæ. When using it, the tracheotomy-tube should be held firmly in, and the sides of the wound compressed round it, to prevent the escape of air. The nozzle of the syringe being then fixed into the orifice of the outer tube, the handle should be drawn out once, and, blood being sucked out, the syringe removed to allow of an inspiration being taken—if necessary, Sylvester's method of respiration being applied. This process should be repeated if required.

4. *Tubes.* The best kind of tracheotomy tube is that

which has been brought forward by Mr. Durham, of Guy's Hospital.* It is a great improvement on the old tube, whose history I shall briefly endeavour to trace, indicating the modifications through which it has passed. The French tube, commonly

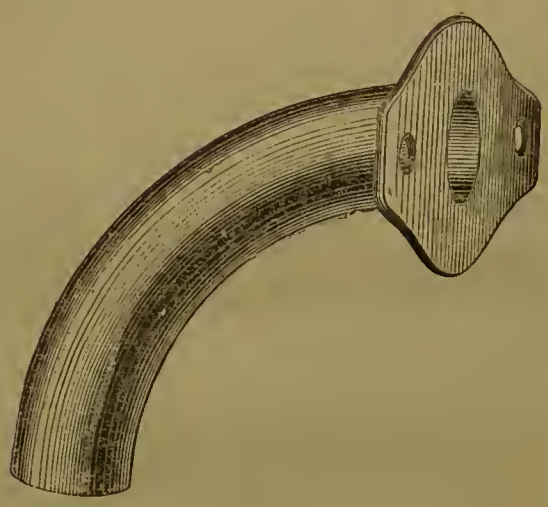

FIG. 3.—Trousseau's tube.

known as Trousseau's (Fig. 3), is the earliest to which there will be occasion to refer, for its shape is the same as that of the tube which has always been in use. In the woodcut it will be seen

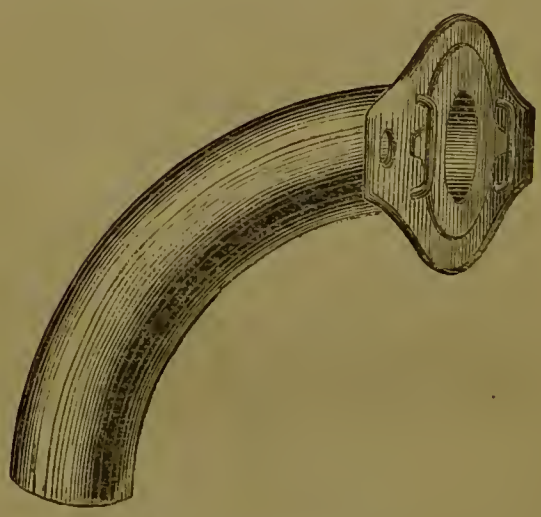

FIG. 4.—Roger's tube.

that the tube is curved from one end to the other, and that it is soldered to the shield. Fig. 4 shows the great improvement introduced by M. Roger, a French surgeon. He made the tube so that it would freely move with the movements of the patient,

* *Practitioner*, April, 1869.

by fixing a necklet round the external end of the tube, with small projections on either side which passed under two flanges of the shield. Previously to this M. Obré had invented the inner tube, to overcome the difficulty experienced when the single tube became clogged by mucus. He had it made so as to project very slightly beyond the outer tube at the tracheal end, in order that on its removal all the mucus would be withdrawn, and would

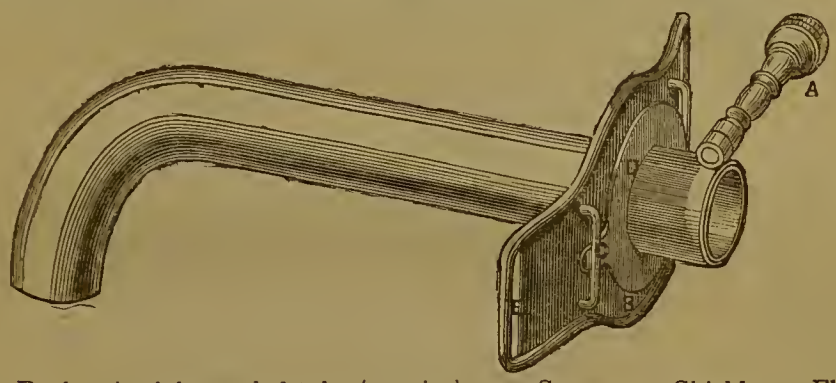

FIG. 5.—Durham's right-angled tube (1st size). A, Screw; B, Shield; C, Flange; D, Necklet; E, Opening in shield for passing tape through.

not stick to the end of the outer tube, as would have happened if it had been of the same length or shorter. Durham's, or the right-angled tube (Fig. 5), is an improvement on Roger's tube in two ways. Firstly, the portion of the canula which lies in the wound is straight, and the tracheal portion forms a right angle to it. By this alteration the tracheal end is prevented tilting against the posterior wall of the trachea, which in the former tube has been a frequent cause of ulceration of the mucous mem-

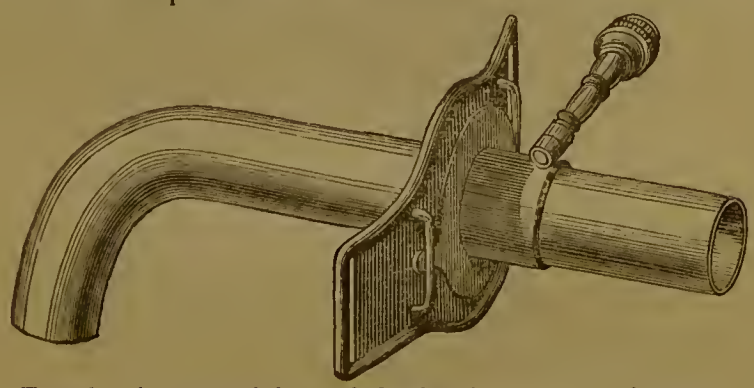

FIG. 6.—An outer right-angled tube showing use of screw.

brane of that part, and occasionally of fatal hæmorrhage. Secondly, the right-angled tube can be altered to any length, so that it can be used when the trachea lies very superficially or deeply. This is managed by means of the screw (Fig. 5, A), which, being loosened, the necklet (D) is opened; and the shield (B, also see Fig. 6)

can then be pushed to the required distance along the canula.

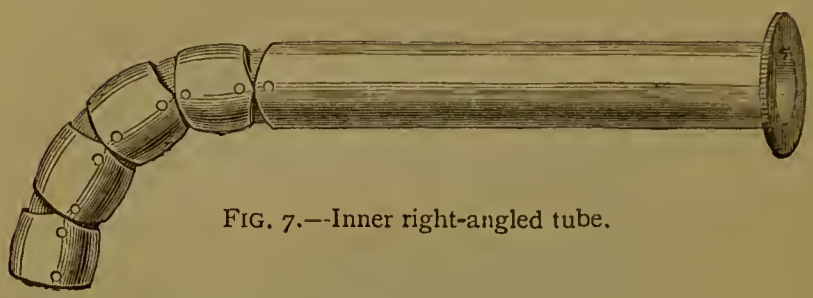

FIG. 7.—Inner right-angled tube.

As the tracheal portion of the outer canula is made at right angles, the corresponding portion of the inner canula has to be divided into segments (Fig. 7). These segments overlap one another internally, and are riveted together. The outer canula has a blunt-pointed trocar (Fig. 8) adapted to it, which enables it to be passed into the windpipe. This arrangement overcomes any difficulty in passing the tube into the trachea after the division of the cartilages, and does away with all necessity for the use of dilating forceps or hooks. A sharp-pointed cutting trocar has been also recommended, which, fitted to the outer canula, and the tracheal rings being laid bare, is pushed into the windpipe. But this instrument is useless, and worse than useless; for as there is not much resistance in the trachea, a great deal of force is required in order to push it in; and from this necessary force it may sometimes slip on either side, or go through into the œsophagus.

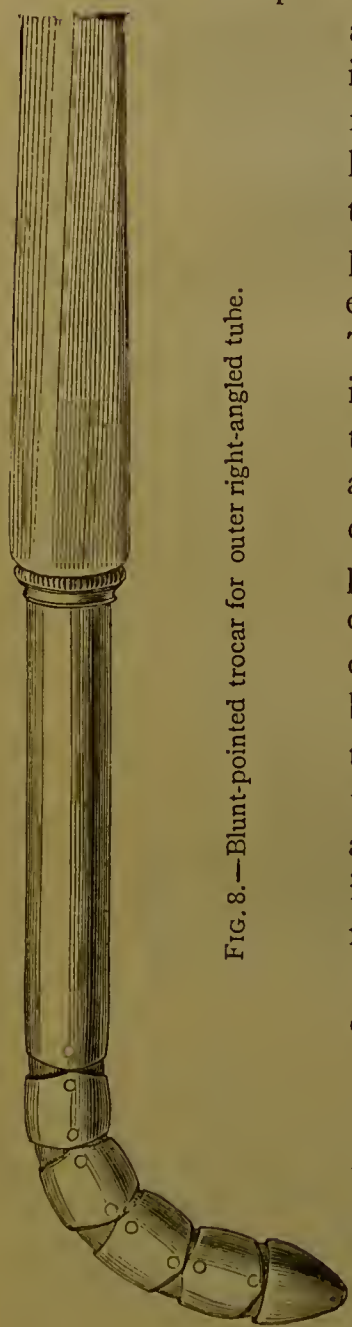

FIG. 8.—Blunt-pointed trocar for outer right-angled tube.

The only objections to the right-angled tube are, that in consequence of the segments of the inner canula overlapping one another internally, mucus is more apt to adhere than if the inner surface of the canula were smooth; and that these seg-

ments may break away from their rivets and fall down the trachea, when the tube has been worn for some time and is not daily attended to (*vide* p. 36).

The tubes are made of four different sizes—

Size in English œsophageal gauge.*	Length in inches from external orifice to bend.	Length in inches of tracheal portion; that is, from the top of the bend to the tracheal orifice.
No. 1.—19 (or 31 in French gauge, or millimetres in circumference) . . .	$2\frac{1}{2}$	$\frac{7}{8}$
,, 2.—17 (or 28 millimetres)	$1\frac{3}{4}$	$\frac{3}{4}$
,, 3.—15 (or 26 millimetres)	$1\frac{1}{2}$	$\frac{1}{2}$
,, 4.—12 (or 22 millimetres)	$1\frac{1}{4}$	$\frac{3}{8}$

The length of the inner canulæ, which are always made to project beyond the outer at the tracheal end about $\frac{1}{16}$ to $\frac{1}{8}$ of an inch, are respectively $3\frac{1}{4}$, $2\frac{1}{2}$, 2, and $1\frac{3}{4}$ inches, and their diameter from $\frac{3}{8}$ to $\frac{2}{3}$ of an inch. The largest tube, or No. 1, is adapted for an adult man or woman; the second size for young people, and for an adult woman if the trachea be small; the third size for boys and girls; and the smallest for infants. They are made of silver. Vulcanite is a lighter material, but to be of sufficient strength, the wall of the tube must be made so thick, that the calibre of its canal is encroached upon. The vulcanite tubes

* The English œsophageal gauge gives no accurate idea of size, and compared with the French gauge, in which the number of the size signifies a similar number of millimetres in circumference, has eleven sizes less, as will be seen by the following table :—

The English	No. 1	is equal to the	French	No. 7.
,,	No 3	,,	,,	No. 9.
,,	No. 4	,,	,,	No. 11.
,,	No. 5	,,	,,	No. 12.
,,	No. 6	,,	,,	No. 15.
,,	No. 11	,,	,,	No. 20.
,,	No. 12	,,	,,	No. 22.
,,	No. 13	,,	,,	No. 23.
,,	No. 14	,,	,,	No. 25.

sold by instrument makers are very likely to get broken during use, and therefore should not be employed.

After the patient has worn a tube for two or three weeks, and it is known that it will be necessary to continue to wear it for a much longer time, perhaps permanently, if the tube which has been hitherto employed has been found to be of the proper length, a tracing of the outer canula should be taken on paper, and a tube made exactly corresponding to the tracing, having its necklet fixed to the rim of the external orifice of the outer tube without any screw, which will be no longer required (Fig. 9). Sometimes an elliptical opening is made in the upper portion of the bend of this permanent tube, to enable the patient to breathe

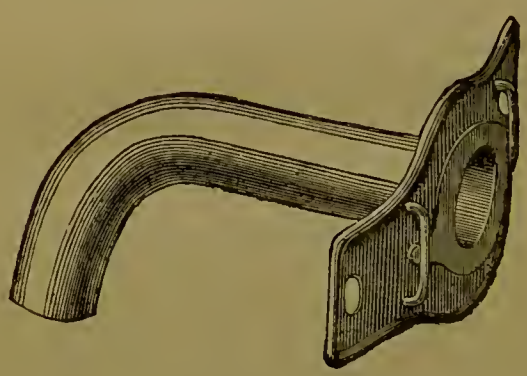

FIG. 9.—Permanent right-angled tube.

partly through the natural passages, and partly through the tube. A serious objection to this arrangement is, that the mucous membrane of the trachea will often after a time rub against the side of the opening, and in this way ulceration will be set up; besides, it is unnecessary to have the opening made, for a sufficient quantity of air will pass by the sides of the tube even when its outer aperture is corked up. The only occasion such a tube will be found of service is when the operation is performed for removal of foreign bodies from the larynx (*vide* p. 61). With this permanent tube valves are sometimes worn. They are, as it were, an extension of the tube, and are made to fit to the inner canula. Fig. 10 shows the valve invented by Luer, of Paris. It contains a pea, which closes the external orifice during expiration, as seen in the woodcut (Fig. 10), and, on inspiration, falls back upon the wire (w), which is seen passing through the valve. Mr. T. Smith, of St. Bartholomew's Hospital, has had one made with an india-

rubber valve. The object of these valves is to do away with the necessity for the patient to close the tube with the finger when he requires to speak; they admit air on inspiration, but do not allow any to escape during expiration. Some few patients find them useful, but generally they complain that they do not

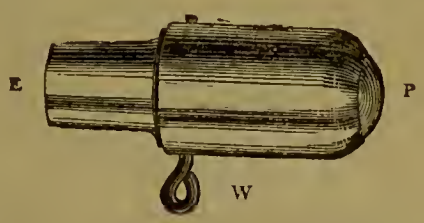

FIG. 10.—Valve showing pea filling up external orifice, as in expiration. E, End for insertion into inner canula; P, Pea; W, Wire, passing through centre of valve.

admit a sufficient quantity of air to enable them to be worn for any length of time; also that in consequence of getting damp, they will not always work easily. This is especially the case with the india-rubber valve. Another objection to the pea valve is, that the continual noise it makes is very unpleasant.

Two special kinds of tubes are required—one for Subcutaneous Emphysema, the other for Stricture of the Trachea. The former should measure from four to two inches from the external orifice to the bend, according to the size of the canula; and the latter from one and a half to one inch in the tracheal portion.

In purchasing tracheotomy tubes, it should be seen that the projections on each side of the necklet, which pass under the shield, are of sufficient length to prevent the tube slipping away from the shield.

It is necessary to notice the more important of the numerous other tubes and instruments which have been recommended for tracheotomy; but the right-angled tube, with its close-fitting, blunt-pointed trocar, is by far the most useful and simple.

1. Dr. Fuller's bivalve tube (Figs. 11 and 12), which is frequently used in this country, has justly been condemned on account of the hæmorrhage it is likely to cause, from the sharpness of the edges of its outer canula. Mr. Marsh,* in ten cases

* St. Bartholomew's Hospital Reports, vol. iii., p. 364.

he has collected of fatal hæmorrhage occurring after tracheotomy, mentions that in six of them the patient wore Fuller's bivalve tube.

2. Sir Henry Thompson's tracheotome consists of a pair of curved cutting forceps, the blades of which, after they have been

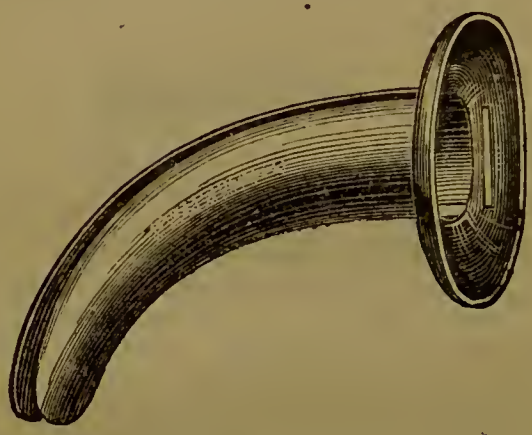

FIG. 11.—Fuller's bivalve tube.

thrust into the trachea, are made to open by means of a screw. Garin's, of Lyons, instrument is similar to this. He employed forceps with bent blades, one being sharp at the point, and projecting a little beyond the other. It was pushed in a closed condition into the windpipe, and then opened.

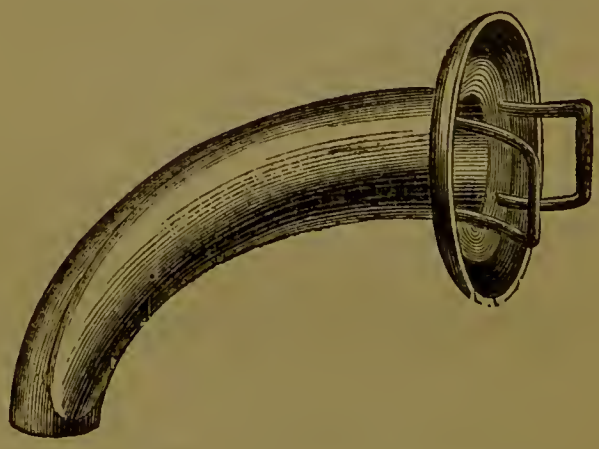

FIG. 12.—Fuller's bivalve tube with inner canula.

3. Maissoneuve's tracheotome is a curved dilating hook, with cutting inner edges. The point is entered between the first and second rings of the trachea, and brought out again between the fourth and fifth. The handle is then carried under the chin, so that the blades are made to cut through the trachea

and skin, between the point of insertion and the point of exit; after which upon pushing a spring the two halves of the hook separate, and the canula may be introduced between them. Langenbeck's dilating hook is constituted on the same principle.* Isambert operated with it in two cases, on the first occasion cutting through into the gullet; the second time he was more successful.

4. Marshall Hall † invented what he termed a "trachea stretcher." A portion of the trachea was cut out, and the opening kept patent by this instrument. It has been known to cause fatal hæmorrhage in the process of drawing it out. ‡

5. Verneuil § has operated by means of the galvano-cautery, using a galvanic knife. Amusat || has carried out the same principle by passing a needle with wire attached into the trachea, and drawing it out at a short distance from the point of insertion. He then fixes the battery to the ends of the wire, which he withdraws by pulling at the two ends with forceps, and thus cuts through the trachea. The object of these methods is to do away with all risk of hæmorrhage. The galvano-cautery has never been to my knowledge satisfactorily tried in this country, but it is unlikely ever to supersede the knife.

Trendelenburgh's canula ¶ is used when tracheotomy is performed preparatory to operations about the mouth and jaws, when a good deal of hæmorrhage may be expected. The blood is prevented from passing down the trachea by means of an india-rubber bag which surrounds the tracheal portion of the canula, and which can be inflated by a hand-ball, connected to the bag by a piece of india-rubber tubing, a tap stopping the air from escaping. The inflated bag fills up the canal of the trachea round the tube, and thus prevents blood from running down into the lungs.** The tube is made to project beyond the

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* *La Tribune Med.*, May 5, 1872.

† *Amer. J. Med. Sci.*, July, 1853, p. 55.

‡ *Med. Times and Gaz.*, vol. xix., p. 359.

§ *Lancet*, May 18, 1872, p. 688.

|| *Archives Générales de Medecine*, Jan., 1873.

¶ *Med. Times and Gaz.*, May, 1872, pp. 510 and 596.

** See a case mentioned by Mr. Bryant, in which he successfully used this tube in removal of a tumour from the palate. *Med. Soc. Proceedings*, vol. i., p. 2.

neck, in order that chloroform may be more easily administered. In thyrotomy this instrument is not of service, as it takes up too much room, and uncontrollable hæmorrhage never occurs during this operation.

IV.—The Operation with the Preparatory and After-Treatment.

A most essential requirement in the operation of tracheotomy is to have a good supply of light. This during the day is naturally to be found opposite a window (if not in an operating theatre), and this situation is in another respect favourable, inasmuch as the blood which may be forcibly coughed out directly the trachea is opened, falls on the window and not on the papered wall. At night time, if there is not a fair supply of gas, or a good oil-lamp, such as a duplex lamp, three equal-sized pieces of candle, fixed on the bottom of a tea-cup, as suggested by Mr. Marsh, will yield a serviceable light. If the teacup be filled with salt, and the three or more pieces of candle stuck into this, then the cup can be put on a table, or held if more convenient. A bull's-eye lantern might be used, if it can be procured. It must be remembered that persons unaccustomed to seeing operations may faint suddenly, and therefore it is unsafe to entrust the light into their charge.

All the instruments and apparatus should be laid out on a table near to the hand of the operator. The outer tracheotomy canula, having been adjusted to the length required, according to the depth the trachea has been felt to be below the skin, should have the blunt-pointed trocar fitted to it, so that it is prepared for passing into the windpipe directly the rings are cut through. The faradaic battery should be put in order for *immediate* use if required. Ice in small pieces, and a solution of iron for styptic purposes, should also be at hand.

Before putting a male patient into position, if his beard is long, it may be kept out of the way during and after the operation by dividing it in the middle and tying it into two portions with tape, and thus saved from being cut off. Tracheotomy may be performed while the patient sits in an arm-chair, provided

the back of the chair be low enough to allow the head to be thrown back; but the more convenient position is on a bed, with the shoulders slightly raised by a pillow, another pillow being placed under the head, and on this the special pillow previously described which should be placed under the neck. The freezing of the skin should be done by an assistant standing at the side, who should be ready after the first incision to apply sponges. The position of the operator is a matter for individual choice, though it will probably be found more convenient and comfortable to stand behind the head of the patient, whilst the unpleasantness of having blood coughed into his face is avoided should there be hæmorrhage.

When the neck is thin, the cut through the skin should be an inch and a half in length; but when the trachea lies deep, it will be necessary to make it rather longer. It may look neater to limit the incision, so as only to allow sufficient room for the tube to be passed in; but there is not the same rapidity or safety in the operation, for the tissues cannot be so easily separated, vessels avoided, or hæmorrhage stopped, as when it is made more freely. In cases where the trachea is contracted, there is also less probability of being able to introduce the tube below the constriction when the cut is limited. It is a good plan in first operations to draw a line in ink, corresponding to the intended incision. In making the first cut, a finger should be placed on the sternal side of the commencement of the incision, as the skin over the trachea is very movcable. The head should be kept perfectly straight, from the commencement to the close of the operation. The rule to be adopted in selecting the seat of incision through the skin is to commence it quite an inch and a half below the first ring of the trachea, if the length of the neck permit, which can be estimated by feeling for the Pomum Adami, with the cricoid below it, and in this way the windpipe being reached between the second and sixth rings. The cut should be carried in a direction from below upwards. The skin divided, it is of practical importance not to use the blade of the scalpel more than is absolutely required, but to separate the muscles and tissues with its handle. This separation may be effected with some force if care be taken to keep in the middle line of the

neck. It is seldom necessary, after cutting through the skin, to use the blade, except for dividing the different layers of cervical fascia, the muscles being, in most cases, readily separated; there is no loss of time in thus operating, and there may be a saving, the delay from hæmorrhage being often avoided. When the knife has to be used, the structures to be cut through should be held up with forceps and sponged, so that it may be seen whether there are any vessels to be avoided. They should be divided by snicking rather than by a free use of the blade, unless the operator is satisfied there is only a layer of fascia, which can be safely incised along its whole length. It may be necessary to cut through the skin, the underlying tissues, and the rings of the trachea at one thrust of the scalpel, but only when the patient's condition imperatively demands that there should be no delay in opening the windpipe. If the neck is short, or the thyroid gland enlarged, its isthmus may come immediately under the incision, leaving no room for an opening into the trachea; under such circumstances it must be cut, or rather worked through, so as to obviate hæmorrhage as much as possible. There is no hard-and-fast rule to go by, but if the incision down to the trachea be kept of an uniform length through its entire depth, it will be easier to deal with difficulties arising from an hypertrophied thyroid, hæmorrhage, unusual depth of the windpipe, enlarged thymus gland, and contraction of the trachea. By the aid of the finger, it may be ascertained when the trachea has been reached, its cartilaginous rings being felt, or this tube may be seen covered only by a layer of whitish fascia. Should there be any bleeding, the windpipe must not be opened until the flow of blood has altogether or almost entirely ceased, unless the patient's condition urgently demands that the operation be completed without delay.

Some writers state that hæmorrhage is often arrested by opening the windpipe, the turgidity of the cervical vessels being relieved through the restoration of breathing. This cannot be relied upon. It is better even in urgent cases to raise the patient to a sitting position, and see if the urgency of the dyspnœa cannot be thus sufficiently relieved to allow the operation to be finished after the bleeding has been controlled. The vessels from which blood escapes should be tied or twisted. General oozing of

blood may be checked by pressure with a sponge or a piece of ice, or by means of a solution of perchloride of iron. If ligatures are needed, it is better to cut both ends off close, otherwise, on passing the tube into the trachea, they are in danger of being torn away, while they cause no trouble in the wound. Roser* met with the accident last mentioned, which led to fatal hæmorrhage. In applying ligatures to veins, care should be taken not to make too much traction upon them, lest air be sucked in.

The assistant should now hold the tube in readiness with the trocar fitted into it. Bleeding having ceased, and the tracheal rings having been properly exposed, these should be cut through by an incision carried from below upwards, and if necessary the forefinger of the left hand placed in the lower angle of the wound to protect either a vessel, or the isthmus of the thyroid, either of which may have been carefully kept out of the way of the scalpel during the dissection. It is usually recommended to divide two rings, but it need only be borne in mind that the opening does not require to be much larger than will admit the canula. This will be found to be about from half an inch to an inch in length, according to the size of the tube to be introduced. Directly the incision has been made, the forefinger of the left hand should be slipped into the trachea, just between the divided cartilages, the scalpel laid down, and the tracheotomy tube passed in, guided by the finger, which has in the meantime helped to prevent any blood from entering the windpipe. The trocar should then be withdrawn, the left hand holding the tube in position. It will be at once evident whether the canula is in the trachea, by the passage of air through it, with the ejection, perhaps, of blood and mucus. If air does not pass, the tube should be withdrawn, the left forefinger again passed into the windpipe, and the tube with the trocar introduced as before. If the opening be found too small, of course it must be enlarged; but though all possible speed is requisite, there must be no flurry at this critical time—doubly critical if blood is flowing down into the bronchi. The patient, directly the canula

* Syd. Soc., 1863, p. 278.

is in, usually struggles to sit up. This should be allowed, a bed-rest being employed for support. The surgeon, with a hand still placed on the tube, in order to prevent it from slipping out, then comes round to the patient's side, and adjusts the tapes. If the tube be either too long or too short, it can be altered even whilst in the trachea, taking care to hold the shield against the neck, whilst in the act of drawing the canula forwards or pushing it further in, as the case may be; but for anyone without much experience, it is perhaps safer to take the tube out, and then to fix it at the required length, afterwards replacing it by means of the trocar. Should the wound extend much above or below the shield of the tube, wire sutures may be used to close it.

The inner tube can now be inserted. Before doing this, it should be held in the proper position to adapt itself to the right angle of the outer tube. A piece of lint, with its upper edge slipped in under the shield and strapped down, will prevent the wound from being irritated by the tracheal discharge. Any subsequent bleeding can generally be controlled by pressure with the finger, or by means of a small piece of sponge held under the shield. If notwithstanding these measures the bleeding continue severely, the canula should be withdrawn; and if the blood is found to come from a cut vessel, a ligature must be applied, the trachea being held open by means of the pitchfork retractors. It may be necessary to employ the measures recommended in the treatment of general hæmorrhage, and ice may be freely sucked if it does not excite coughing. The patient should not be disturbed for some hours, but should remain on the bed supported by a bed-rest, more especially if there has been considerable hæmorrhage. A small quantity of some alcoholic stimulant may be given if required. If there has been no bleeding during or after the operation, the requisite nourishment can be administered out of a cup; otherwise it must be given by means of a spoon, everything being taken cool. It may be desirable to employ enemata.

All things being satisfactory, sleep may be allowed as soon as the disposition to it is felt, this being often very grateful to one whose rest has been long disturbed; but should there be hæmorrhage, the patient must be kept awake until all danger from this source is past, and on no account allowed to get into

such a condition that he cannot cough up the blood out of the air-passages. For the first twenty-four hours or so the secretion may constantly require to be cleared from the inner tube by the aid of feathers; and if very thick and tenacious, the tube itself may have to be removed every ten minutes, and washed out in hot water. The bristle brushes fixed on wire, sold for cleaning tobacco-pipes, answer very well for the outer canula, but not for the inner one, as the hairs are apt to catch in its segments. The way to use the feather efficiently is to pass it quickly in as far as the end of the tube, and then with half a turn to bring it rapidly out, pressing against the side of the canula, and thus pulling the mucus along with it. If the patient is able to cough up the mucus easily, and there is no fear of hæmorrhage, he may be allowed to do so, the expectoration being caught at the orifice of the tube with a small piece of sponge or rag, which should be burnt after use; or instruction may be given to cough up the secretion through the mouth by closing the orifice of the tube with a finger; but this can only be done, especially at first, when the laryngeal obstruction is incomplete. Some patients learn to perform this act in a few hours, whilst others take days to accomplish it. Removal of the outer tube will seldom be necessary until after the third day, if the nurse understands her duties, and pays constant attention to the clearing out of the inner tube. Should it become blocked during the first few days, a competent nurse may be able to take it out, but could not be trusted to replace it, as a single failure to reintroduce the tube at this time is dangerous, the opening not being thoroughly patent. She should be instructed that, in the event of the tube having to be removed, traction must be made on either side of the wound with her fingers, in order to keep the trachea open until assistance has arrived. For this reason surgical aid should always be near at hand, certainly for the first forty-eight hours. In ordinary cases the outer tube should not be disturbed until the third day, when the passage will have become fairly patent. After this time it should be taken out and cleaned every day. If there has been much bleeding after the operation, it will be advisable to defer its removal until the fifth day. In croup and diphtheria the tube may require to be taken out at any time

after the operation, on account of the exudation completely blocking it up. If this should be the case, the pitchfork retractors should be employed to hold open the windpipe until the tube has been made clear.

In order to enable the patient to speak, a finger must be placed over the orifice of the tube, that air be prevented from passing through it. The ability to speak will vary in proportion to the degree of laryngeal stenosis, but at first there is always a difficulty in sustaining even a few words. It is soon enough to teach the way to produce the voice after the second day, and then only provided the patient has progressed satisfactorily. Until the voice can be used a slate should be provided.

Four or five days after the operation the patient may be shown how to take out the inner canula, and, later still, when the wound is quite smooth, how to remove and reintroduce the outer canula. Both these processes can be indicated by holding a mirror in front of the patient. In hospitals, should there be anyone in the ward who has for some time worn a tube, the patient recently operated upon will, as a rule, quickly learn by seeing the other take out and put back the tube. Before reintroduction of either canula, it should be dipped in warm water, to assist its passage and take the chill off the metal, shaking or blowing the water out before passing it in, lest drops falling into the trachea may bring on a fit of coughing.

Sutures may be removed generally on the third day, or at any time when union is seen to have taken place; when they show signs of cutting through; or on the occurrence of emphysema. Granulations of the outer wound may be kept down by applying nitrate of silver daily; if they are allowed to form a sphincter, the patient will be unable to be long without the tube—certainly not for a sufficient time to clean it. Where the granulations are of a cancerous nature, and a continuation of a tracheal growth, it is almost impossible to destroy them. From their rapid growth they will sometimes push out the tube, and block up the tracheal opening.

There is rarely any occasion to envelope a patient in steam, as is often done, but simply to have the bed guarded from draughts, a fire being kept up night and day. Perhaps in cases of

croup and diphtheria it may be found beneficial to render the atmosphere moist. In all other diseases experience has made me confident in the opinion that no good purpose is served by employing steam; and if not harm, certainly discomfort to the patient and to those in attendance is caused by it. If it is considered desirable, Dr. Gee's apparatus answers best for the purpose.

The diet for the first few days should be entirely restricted to fluids, especially if there has been much hæmorrhage. Should any difficulty arise in the patient's swallowing, there being no disease of the gullet to account for it, most probably it will be found that the tube is too long, and presses on the back wall of the trachea, thus interfering with deglutition.

At the end of a fortnight or three weeks, if the tube has required no alteration for some days, and it has been judged by the appearance of the larynx that an instrument will have to be worn for a long time, perhaps continuously, a permanent canula (Fig. 9, p. 18) may be made. When the power to breathe through the larynx is partially restored, but not enough for the patient to be enabled to do without the tube; or if the breathing should seem to be sufficiently free, but the glottis is not seen to be so patent but that a sudden attack of dyspnœa might not at any time happen; or the tube is required during sleep, then the inner canula should be worn corked, until it is considered justifiable to allow the whole apparatus to be removed. In having the inner canula corked, perfect safety is ensured; for should difficulty of breathing come on, it can at once be withdrawn, and respiration carried on freely through the outer tube. If the tube is removed permanently, the sides of the tracheal opening must be brought together very closely with strapping, which should be reapplied morning and evening. It is essential that a close apposition of the lips of the wound be maintained; otherwise, in consequence of the rapid union of the approximated parts, an aërial fistula will be soon formed, which is difficult to obliterate. Should this untoward event happen, the application of the galvano-cautery wire to the sides of the fistula, which are afterwards drawn together by means of some very narrow strips of plaister, will close the opening; but an aërial fistula ought never to be allowed to form, for if the strapping

is properly applied at first, the wound will unite along its whole length in a few hours, although the tube may have been worn for many months.

A person who wears a tracheotomy tube should wear a light scarf on going out into the open air, so that it falls over its opening, but is so arranged that the finger can easily close the tube when talking, if a valve is not worn (*vide* p. 18, and Fig. 10).

V.—Dangers during and after Tracheotomy.

Some dangers and difficulties which are liable to arise during the performance of the operation of tracheotomy have already been pointed out, but there are certain special dangers which demand particular notice, and which are attributable to the following causes:—

1. Slowness in operating.
2. Fixing the head too far back.
3. Passage of blood down into the air-passages.
4. Inability to introduce the canula into the trachea.
5. Entrance of air into the veins.

1. *Slowness in operating.*—This is obviated by dexterity with due caution and rapidity in reaching the trachea, which is especially to be attained by using the handle of the scalpel, and not picking up and cutting every portion of the tissues. Sometimes, when the operation is unavoidably tedious, and the breathing much embarrassed, the patient may be allowed to sit up for a short time, and thus may be sufficiently restored to enable the operation to be completed. Should the condition of the patient be extremely urgent, no time must be lost, but the trachea must be cut into without delay, whatever the risk from hæmorrhage may be.

2. *Fixing the head too far back.*—The danger arising from this is, that it may cause a sudden laryngeal spasm, which may prove of serious consequence, and require the windpipe to be opened immediately. Before commencing to operate, the pillows should be so arranged that the trachea is thrown as much forward as the state of the patient's breathing will permit. Should a spasm come on, it may generally be subdued by making the patient sit up, as mentioned in the previous paragraph.

3. *Passage of blood down the trachea.*—This constitutes one of the greatest dangers of tracheotomy. Where the condition of the patient does not imperatively demand the completion of the operation, the trachea should never be opened whilst hæmorrhage of any consequence is going on. Should there be severe bleeding after the canula has been introduced, it will usually be found that pressure with the finger or with a piece of sponge underneath the shield of the tube, will be sufficient to check it. When the blood has passed profusely into the bronchi, and the patient is unable to eject it, even though coughing has been induced by passing feathers into the trachea, it should be drawn up by the aid of the syringe described in the list of instruments; or if the operator has not this at hand, he will do well to apply his mouth to the orifice of the tube and suck the blood up, remembering afterwards to rinse the mouth out thoroughly with brandy, especially when there is any fear of infection. Should this not be done, the only plan will be to roll the patient over on to one side of the chest a few times, according to Marshall Hall's method of artificial respiration, in order to enable the blood to run out of the tracheal wound. After removing the blood, if the breathing is not restored, Sylvester's method of artificial respiration should be resorted to; or faradisation, one pole being applied at the back of the neck and the other over the cardiac region. In one case at which I was present some years ago, the value of faradisation was remarkably manifested. For more than an hour artificial respiration had been carried on, it being found that when it was left off the breathing ceased, and the pulse dropped immediately. A battery was obtained, and the patient under its influence quickly and permanently rallied. Dr. B. Richardson's bellows (Fig. 13) will, I think, when they have come more into use, be found of great service in restoring suspended animation. The bellows consists of two india-rubber balls, A and B, joined together, each capable of containing four cubic inches of air; and from these balls run two tubes, which terminate in a nozzle, D.* At a short distance from the

* This nozzle should be made similar to the one in the suction-syringe, that is, graduated and covered with india-rubber.

ball, A, is another smaller one, C, which acts as a reservoir. The action is as follows :—The balls A and B are squeezed together, and, before being allowed to expand, the end of the tube, D, is placed in the canula. Then the balls being allowed to expand, from the arrangement of the valves inside, air is drawn into B from the lungs, whilst the other, A, fills with common air. On again compressing them, the fresh air in A passes into the lungs, through the smaller bag, C, which prevents undue tension of air upon the lungs; in the meantime, the air in B, already drawn from them, is squeezed out into the surrounding atmosphere. The exhausting ball should first be used, and then the other to fill the lungs; the pressure at the commencement should be made very gently. Dr. Richardson recommends, where the chest is capacious, that five consecutive strokes should be made with the ball A, that passes air into the lungs, and then three

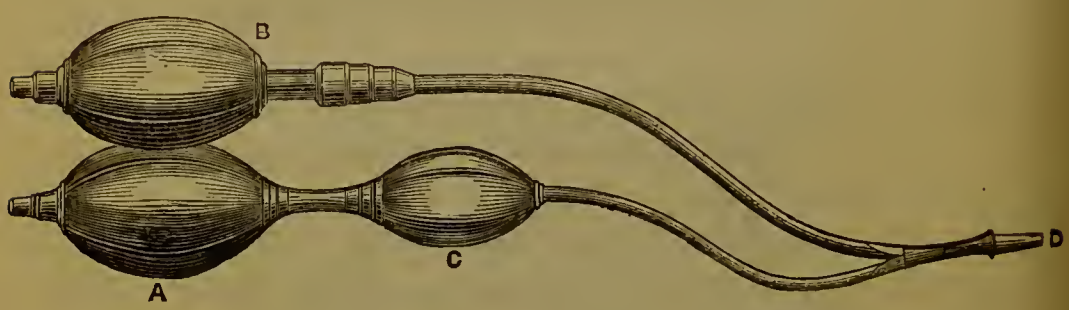

FIG. 13.

with the ball B, which withdraws the air from the lungs. This process may be repeated ten times a minute.* Two cases reported by Dr. Richardson in the *Medical Times and Gazette*† show very strongly the value of this instrument. In the first case, after tracheotomy had been performed for diphtheria, a child's breathing was restored on five separate occasions, on two of which the child was to all appearance dead. In the second case a child was resuscitated many times within a short period.

4. *Inability to introduce the canula into the trachea.*—This *contretemps* may arise (*a*) from the trachea not having been

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* *Med. Times and Gaz.*, Dec. 4, 1869, p. 619.

† Aug. 2, 1873, and July 17, 1875.

opened at all; (*b*) from the tracheal opening not having been made large enough; or (*c*) from there being a stricture of the trachea below the incision for the introduction of the canula.

(*a*) *The trachea not opened.*—Amongst cases reported in which this mishap took place, are one by Mr. Marsh,* and another by Mr. Green of Bristol. † I have seen, at the *post-mortem* examination of a child at one of the London hospitals, three cuts on the vertebral column, which had been made by a house-surgeon in fruitless attempts to open the trachea. This unfortunate occurrence is more likely to happen to an operator in his earliest cases, and especially when the subjects are infants in whom the trachea is very small and placed deeply. Any uncertainty with regard to opening the trachea is best avoided by holding it up with the sharp hook.‡

(*b*) *The opening not being large enough,* or, more correctly speaking, long enough, may happen even to an experienced surgeon when he is afraid of cutting up too far, the trachea having been opened immediately beneath the thyroid gland. The knife, directed by the finger, must in this event be passed in again, and the opening lengthened in an upward direction, dividing the gland if need be, should there be no time to dissect it away. To prolong the incision downwards is more dangerous. Subcutaneous emphysema may be the consequence of not making the opening into the trachea large enough at the outset.

(*c*) *Stricture below incision.*—The following case, which was amongst my first operations, exemplifies the danger and difficulty arising from such a condition:—A man had extensive syphilitic thickening and ulceration of the larynx, sufficient to account for the dyspnœa under which he was labouring, and necessitating

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* *Bart. Hosp. Rep.*, vol. iii., p. 368. In this case the tube remained so long in the cellular tissue in front and lower portion of the trachea, that it caused fatal hæmorrhage by ulceration into the innominate vein.

† *Brit. Med. Journ.*, Dec. 17, 1870, p. 649.

‡ It may be impossible to divide the tracheal cartilages, on account of their ossification, unless a saw or cutting forceps (mentioned at page 11) are used. In the event of neither of these instruments being at hand, by freely notching the edge of a scalpel and using it as a saw the difficulty may be overcome.

tracheotomy. Having cleared the tissues, so that the rings of the trachea were to be felt uncovered, I inserted the scalpel, cut upwards, and attempted to introduce the tube. No air escaping, I immediately withdrew the tube, and enlarged the opening. The dyspnœa was now excessive. The patient threw his arms about, and gasped; still no air came through the tube, which I could feel had passed between some cut rings of the trachea. Pressure was made on the chest, Sylvester's method and the battery employed, but without success, for restoration could not be effected. The *post-mortem* examination showed that, besides the thickening and ulceration of the larynx, which had been observed with the laryngoscope, there had been extensive ulceration opposite my point of incision, which had been followed by cicatricial narrowing, leaving an opening only about the size of a quill pen for the air to pass through (*vide* Photograph I.). It was also seen that though I had cut some rings, yet that that portion of the trachea was completely formed of solid cicatricial membrane, with which the rings were incorporated. In making the wound down to the trachea, I had allowed it to get funnel-shaped, thus having insufficient room to open the trachea further.

5. *Entrance of air into veins.* This is a possible accident when a vein about the neck has been incised, and traction is made upon it, and therefore this danger should be remembered in the performance of tracheotomy. Mr. Erichsen, in his book of Surgery,* describes two sets of phenomena attending the entry of air into the veins, viz., local and constitutional. The local phenomena "consist in a peculiar sound, produced by the entrance of the air, and in the appearance of bubbles about the wound in the vein. The sound is of a hissing, sucking, gurgling, or lapping character, and never fails to indicate the dangerous accident that has occurred." "The constitutional effects," he goes on to say, "are usually very marked. At the moment of the entry of air, the patient is seized with extreme faintness, and a sudden oppression about the chest. He usually screams out, or exclaims that he is dead or dying, and continues moan-

* 6th Edition, vol. i., p. 255.

PHOTO. I.—Illustrating Syphilitic Cicatricial Narrowing of Trachea. The ulceration is seen to extend from the vocal cords to the lower end of the stricture (*b*).

e, Epiglottis.
v.c, Vocal cords (thickened and ulcerated).
a, Upper end of tracheal stricture.
b, Lower end of same.
c, Portion of healthy mucous membrane of trachea, immediately above the bifurcation.

ing and whining; the pulse becomes nearly imperceptible, and the heart's action labouring, rapid, and feeble; death commonly results, but not instantaneously, in many cases, at least." The treatment, according to this writer, is to compress the wounded vein with the finger, and, if practicable, to secure it by a ligature, thus preventing the further ingress of air; to compress the axillary and femoral arteries; and to place the patient in a recumbent position, in order that there may be a free circulation of blood in the head; and, lastly, to perform artificial respiration; for it has been found by experiments on dogs that a very small quantity of air will be found in the cavities of the heart, or in the branches of the pulmonary vessels, compared to the quantity injected.

The untoward events which are liable to follow an operation may be divided into three classes—1. Accidents which may happen to the canula itself, or in connection with it. 2. Pulmonary complications. 3. Miscellaneous.

1. The accidents to or in connection with the canulæ are—

(1) Dislodgment of the canula out of the trachea.

(2) Ulceration of trachea in consequence of undue length of canula.

(3) Breaking off of a portion of inner tube, the terminal piece falling down the trachea.

(1) *Dislodgment of the canula out of the trachea.* This may result from the tube not being of sufficient length; or from the tapes round the neck not being applied tightly enough or securely fastened, so that a violent fit of coughing causes the tube to slip out of the trachea. Further, it may come out if the projections on each side of the necklet of the tube, which fit under the shield, are not sufficiently long. Should the tube be lying in the wound, it may at first sight seem to be properly *in situ*, for the patient may be still breathing quietly; but to a practised ear the air will be heard to pass along its sides; and on holding a moistened finger at a short distance from the canula, no air will be felt coming through it; and, further, if the finger be placed over the orifice of the tube, the patient's breathing will not become oppressed. In order to rectify this condition, the tube must be removed, lengthened if necessary,

and again passed in. Subcutaneous emphysema may arise from this accident.

(2) *Undue length of canula, causing ulceration of the trachea.* This condition is recognized by the patient complaining of pain in deglutition, even on swallowing saliva; and during this process the head will be seen to be bent forward. To remedy such an accident, the tube must be removed and adjusted to the proper length.

(3) *Breaking off of a portion of inner canula, the terminal piece falling down the trachea.* Owing to the sudden bend of the tracheal end of the outer canula, which obliges the inner one to be made in segments, each segment being riveted to its fellow, this accident is liable to occur, unless the patient is most careful every day when cleaning the canula to examine the rivets. Some of the London Hospital Museums contain illustrative specimens. By having the bottom rim of the outer tube slightly turned in a segment of the inner canula breaking off is checked in its descent, and cannot slip beyond the outer one; but this plan can only be applicable when the expectoration has almost entirely ceased, otherwise it would constantly be accumulating between the rim and the inner tube.

At the beginning of 1874, a clergyman, upon whom I had operated for chronic laryngitis in the previous May, broke his tube away from the shield whilst trying to clear it of mucus, by pushing in a cedar pencil with which he was writing, and it slipped into the right bronchus (*vide* Photograph II.). The tube was made of vulcanite, fixed to a silver shield. He had been repeatedly warned that inserting his pencil in such a manner was a dangerous procedure.

As an illustration of the condition to which a tube may be allowed to fall, and how careless individuals of the poorer classes are apt to become, I will refer to a paper read by Mr. Pick at the Pathological Society.* Mr. Pick had operated on a man at St. George's Hospital for syphilitic laryngitis in January 1864. Very shortly after the operation, the man, though he could not be induced to have the tube removed, went about

* Vol. xxi., p. 416.

PHOTO. II.—Illustrating Portion of Tracheotomy-Tube lodged in the Left Bronchus, it having broken away from its shield, and slipped down the trachea.

t, Tongue.
e, Epiglottis.
v.c, Vocal cords (thickened and ulcerated).
o, Tracheal opening for tube.
c, Post-mortem cut sewn up.
sc, External portion of tube, the screw showing how it was attached to the shield.
l.b, Left bronchus, with tube lodged in it.

with a cork in it. He was then discharged from the hospital, and was not again seen till September, 1869, when he was still wearing the tube, such as it was. He stated that for the last two years he had never removed it. "The whole of the outer tube," which was exhibited, "had become oxidized and eaten away, so that nothing remained of it but the shield, which lay external to the windpipe. The inner tube was also partially destroyed, at least half of it having disappeared. The portion remaining was much thinned, and had an eroded margin where the parts had been eaten away."

2. *Pulmonary complications.* One or other of the pulmonary affections already enumerated is always liable to arise after the performance of tracheotomy, but they are particularly to be feared when the operation has been resorted to in cases of laryngeal croup, diphtheria, or acute œdema of the larynx. In croup and diphtheria, the air-passages below the seat of operation may become affected from direct extension of the inflammatory process. Bronchitis is particularly apt to be excited if much blood has escaped into the windpipe. Lobular collapse and consecutive catarrhal pneumonia are much to be dreaded if there is any obstruction to the escape of materials out of the lungs, and if the respiratory power is deficient. Should either main bronchus be blocked up by a foreign body, the corresponding lung will become completely collapsed. Pulmonary complications are best guarded against by protecting the patients from draughts, and always having a good fire in the room. It is desirable to make a careful physical examination of the chest from time to time, in order to detect the earliest signs of any morbid condition of the lungs. Should either of these arise, its treatment must be conducted on ordinary principles.

3. *Miscellaneous complications.* (1) Subcutaneous emphysema; and (2) the passage of false membrane into the trachea after the operation.

(1) *Subcutaneous emphysema* has been mentioned previously as being liable to happen when the tracheal opening has not been made sufficiently large, and also if the tube should get dislodged from the trachea. It will further be noticed as being one of the signs of *rupture of the trachea.* Emphysema may arise in cases

where the tracheal opening has been made to one side of the flesh wound, and there is delay in the introduction of the canula, because there is no direct escape for the air. The treatment required is, immediately to secure a free passage for the air through the tube, which may have to be as much as four inches long in the shank (*vide* special tubes, p. 19); and if the emphysema is extreme, so that it interferes with the respiratory movements, the skin should be punctured in various places.

(2) *Passage of false membrane into the trachea.* This complication is treated of under *Croup and Diphtheria,* and requires no further mention.

VI.—Diseases and Injuries requiring Tracheotomy.

The diseases and injuries for which tracheotomy has been performed may be arranged in two groups—the first including those which affect the larynx and trachea; the second comprising certain miscellaneous conditions.

Group I. may be arranged according to the following plan :—

A. Acute diseases—
   1. Acute Œdema of the larynx.
   2. Croup.
   3. Diphtheria.

B. Chronic (organic) diseases—
   1. Chronic Laryngitis.
   2. Syphilitic Laryngitis.
   3. Laryngeal Phthisis.
   4. Carcinoma.
   5. Non-malignant growths.

C. Neurotic diseases—
   1. Paralysis of the abductors of the vocal cords.
   2. Spasm of the adductors of the vocal cords.

D. Traumatic conditions—
   1. Scalds of the larynx.
   2. Corrosion of the laryngeal mucous membrane by certain irritant poisons.
   3. Poisonous bites inflicted by certain insects about the head and neck.

4. Incised wounds of the throat.
5. Foreign bodies in the air-passages.
6. Rupture of the trachea.
7. Injury to the laryngeal cartilages from blows, etc.

Group II. Miscellaneous diseases—

Goitre, Lymphadenoma, Retro-pharyngeal Abscess, Tonsillitis, Epilepsy, Apoplexy, Tetanus, Hydrophobia, Drowning, Hanging, and Suffocation from Inspiring Noxious Gases.

A.—1. *Acute Œdema of the Larynx.* Some writers regard acute œdema of the larynx as being invariably the result of acute laryngitis, and therefore always preceded by marked congestion of the mucous membrane. Though commonly originating thus, there certainly are frequent exceptions. In two instances in which I had the opportunity of observing the condition quite at the outset, the œdema undoubtedly arose independently, and did not follow upon congestion of the mucous membrane, but appeared in tissues apparently healthy, or, if anything, paler in colour than normal. Acute œdema of the larynx, in its severe form, is a disease which runs a most rapid course. Dr. Wood* relates a case in which it terminated fatally in seven hours. The œdema attacks the epiglottis and the arytenoid cartilages, usually simultaneously, the ventricular bands (false vocal cords), becoming as a rule subsequently involved. In an extreme case the epiglottis might only be visible, though portions of the arytenoid cartilages can generally be seen. The right side of the larynx will commonly be found to be attacked first.

By far the most reliable plan of treatment in cases of œdema of the larynx is scarification, which should be carried out very freely. In order to scarify the lower portion of the epiglottis and the arytenoid cartilages, a laryngeal scarifier is necessary; but if the œdema has become extensive, it will not require a laryngoscopist to be able to scarify, for the epiglottis will be readily seen on depressing the tongue, like a broad bean projecting up at its base, though it is very desirable that the deeper parts should be punctured as well. The scarification should be

* Pract. of Med., vol. i., p. 780.

repeated every ten minutes, the patient being directed to gargle continuously with water as hot as can be borne, in order to encourage the bleeding. If this does not afford relief, tracheotomy must be had recourse to without delay. The prognosis under such circumstances cannot be considered favourable; for though the patient may be immediately rescued from suffocation, yet pulmonary complications, as bronchitis, pneumonia, or œdema of the lungs are very likely to supervene, as happened in the sad case of the late Dr. John Murray. Fortunately scarification, if performed in time, can hardly fail to prevent the necessity for opening the windpipe.

The œdema which comes on in the course of fevers requires similar treatment. That complicating typhoid fever is stated generally to run on rapidly to ulceration of the laryngeal cartilages. Erysipelatous œdema should also be treated in the same way. In most instances of this form of œdema the uvula and the surrounding tissues are the seat of œdematous infiltration; the skin and muscles of the neck become inflamed, passing into a brawny condition, with a tendency to slough. When the uvula is attacked it should be at once excised. The prognosis in these cases is exceedingly grave, tracheotomy under such circumstances being a most difficult operation, and the state of the patient very critical. Nevertheless such a condition is not necessarily fatal.

The following case, which came under my care, was a striking example of the value of free scarification in acute œdema of the larynx :—* †

A cabman, on Saturday night, January the 9th, 1875, having gone to bed at nine o'clock, woke up an hour afterwards with the two shirts he had on wet through with perspiration. He changed them for two more, and went to sleep again. In about an hour he again woke up, in the same state of profuse sweating. He changed his shirts, and took a glass of hot rum and water, and soon fell asleep, not awaking until morning. His breathing then was slightly oppressed; and when he came to take his break-

* Read before the Clinical Society, Feb. 11, 1876.

† Most of the cases reported in the following pages came under my care at the Hospital for Diseases of the Throat, in conjunction with my colleagues, to whom I would express my obligation for their courtesy in permitting me to bring them forward.

fast, he found some difficulty in swallowing. He did not become materially worse until Monday night, which he passed in a very restless state; and in the morning his breathing was noisy, and he was unable to take solid food. Tuesday night he was obliged to sit propped up in bed, and slept only "off and on." On Wednesday morning his symptoms were greatly aggravated, and at mid-day he was sent to me by Mr. W. H. Evans, of South Hampstead, with the request that I would admit him, if possible, into the Throat Hospital. He was at this time unable to swallow even a teaspoonful of fluid, and his face was getting livid, from the extreme dyspnœa under which he was labouring. On examination the epiglottis was seen rising up as an œdematous mass, and the arytenoid cartilages were observed to bulge out in the same œdematous condition. There was more œdema on the right side, but on both sides it was very extreme. and the wonder was that the man had managed to breathe at all through a larynx so much obstructed. If it had not been that the left side was less affected than the right, I think he must have been suffocated before I saw him. I immediately scarified these parts very freely—the portion of the mucous membrane covering the epiglottis by means of a gum lancet on a long handle, and the lower portion with the arytenoids by an unguarded laryngeal scarifier. The man was then immediately made to gargle as well as he could with hot water, and told to encourage the bleeding by a sucking action. When the bleeding ceased, which was in about ten minutes, his throat was scarified again, when none of the former incisions could be seen. After the first scarification, his breathing improved wonderfully, his face recovering its natural colour. He took some milk out of a spoon directly after the second operation, and within an hour from the first scarification he was able to drink beef-tea and brandy-and-water from a cup. Two hours later I scarified the parts again; at this time the glottis could just be seen on a deep inspiration. From this period the patient made an uninterrupted recovery, and at the end of a month his larynx had lost all trace of the œdema, and presented a perfectly normal appearance. The right arytenoid was the last portion to retain any œdematous aspect. It was obvious that there had never been any ulceration in the larynx. There was a slight trace of albumen on the day that he came into the Hospital, but it had completely disappeared at the end of forty-eight hours. The same evening his temperature was noticed to have risen one degree, but on the following day it was normal.

The man's account was, that for a fortnight before his illness he had been doing night work as well as his usual day work; that he had only been able to get four to five hours' sleep daily during the whole fourteen days; that he had been obliged to wash his cab night and morning when the weather was bitterly cold; and that on three occasions he had driven all night after getting his feet wet through. Until the night on which he was taken ill, he had for years enjoyed good health—even during this fortnight of hard work, though he had always felt tired, and "frozen to

death by the cold." He had never suffered from syphilis, and was a temperate man.

A.—2 and 3. *Croup* and *Diphtheria.* It will not be suitable in this small work to discuss whether these diseases are one and the same malady; but as they require similar treatment, they will be classed together. There are no cases which more fully reward the practitioner than those belonging to this class, where tracheotomy seems inevitable, and yet where by unremitting attention and watching the operation can be avoided. In these diseases tracheotomy is far less satisfactory than in any other morbid condition in which this operation is admissible, excepting, perhaps, when it is performed for scalds of the larynx; and therefore, if there should be any chance of recovery without resorting to this measure, the chance should be given. Recently I was with a case of diphtheria from six o'clock in the evening until about the same time the following morning. The breathing, though continuously bad, was not such as to require tracheotomy; but the danger lay in constantly recurring paroxysms of a very severe charaeter. Not until midnight did these attacks become less frequent and less severe, and ultimately towards morning the patient was in a condition of safety, so far as the laryngeal symptoms were concerned.

I would here lay down certain rules which are applicable to the performance of tracheotomy in croup and diphtheria, and these are as follows :—

1. When the excessive difficulty of breathing is paroxysmal, and the pulse keeps fairly strong, operative procedures should be delayed as long as possible.

2. When the breathing is continuously difficult, while the respiratory efforts of the patient are strong, the intercostal spaces being forcibly drawn in, and the inspirations are stridulous—signs which indicate that the membrane is in the larynx, but has not passed down into the bronchi—should these indications increase in severity, the operation ought to be resorted to, and with every prospect of recovery.

3. When the respiration, instead of being violent, is feeble, and the whole appearance, as well as the examination of the patient, show that the exudation has passed into the large and

small bronchi, then, though the operation may be done, it must be considered that the probability of recovery is exceedingly small.

With regard to cases which come under the third class, it must be remembered that there are instances on record in which entire membranous casts of the trachea and bronchi have been coughed up through the mouth; accordingly, it may possibly happen that the patient will be able to cough up the membrane through the tracheal opening when he has not the strength to do so through the glottis. Certainly there will be greater facility for the surgeon to deal with the exudation by removing it with forceps, or by constantly applying lactic acid * (grs. xx., ad ℥j.) by a hand-ball spray, which agent has the property of dissolving diphtheritic membrane. For these reasons, the decision must not always be against operative measures. No amount of albuminuria need affect the question.

If when the trachea is opened any exudation should obstruct the tube, it must be pulled away with the forceps, the trachea being held open by the aid of the retractors, otherwise the patient may be speedily suffocated. If the external wound should take on an unhealthy sloughing action, linseed poultices must be applied, spread on surgical oakum. If there be any bagging at the lower part of the wound, it should be washed out with a weak solution of carbolic acid, nitrate of silver, or black wash. Great care must be taken to keep the tracheal discharge from this part. Should the anterior wall of the trachea show signs of sloughing, the tube must be removed.

In 1871 there was a discussion as to the advisability of performing the operation on children under four years of age. Cases were reported in which the operation had been performed successfully—once by Dr. Bell, of Edinburgh, † at six and a half months; in another case by Mr. Lawson Tait, of Birmingham,‡ at seven months; and in another by Mr. Cooper Forster,§ between ten and eleven months old. The youngest case on

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* Dr. Young, of Florence, informs me that the action of the lactic acid is much increased by using lime-water in the place of water.

† *Brit. Med. Journ.*, April 18, 1871.

‡ *B. M. J.*, April 15, 1871.

§ *B. M. J.*, March 27, 1871.

record which terminated in perfect recovery is undoubtedly that of Dr. Seoutellen,* Professor at the Military Hospital at Strasburg. He operated upon his own daughter, an infant six weeks old. The tube he first used was made out of a No. 6 gum-elastic catheter. Afterwards he put in one of silver, leaving the rings for the tapes. This canula was definitely removed on the tenth day.

B.—1. *Chronic Laryngitis.* When this disease has passed beyond simple congestion of the larynx, and leads to thickening and ulceration of the ventricular bands, as well as of other parts of the larynx, it can be prognosticated that tracheotomy will shortly be required, and, further, that the disease will induce necrosis of the cartilages, which will be before long followed by death. It seems to be a purely local laryngeal affection. In the illustrative cases described, which merely represent many others, there was neither evidence of cancer, phthisis, nor syphilis. The disease continues often for years, simply with congestion of the vocal cords during the winter, which subsides either completely or almost entirely in the summer months. Generally, as the frequency of the attacks increases, so the disease becomes more aggravated, until, in addition to congestion with hoarseness, thickening of the tissues with consequent difficulty of breathing comes on, and the malady then advancing with rapid strides, tracheotomy becomes necessary.

In the three cases hereafter alluded to the periods which elapsed from the first attack to the performance of tracheotomy were three, eight, and ten years respectively. In one case in which I performed the operation, there was a history of an almost annual hoarseness for twenty-five years. In recommending operative interference in chronic laryngitis, one can always feel assured that this will prolong life for a period ranging from some months to a year and a half. In the first case the patient lived for a year and two months, and in the second for a year and seven months after the operation. They mostly die from starvation, caused by pressure on the œsophagus by the necrosed cartilages, more especially the cricoid. Disease of the cartilages is often attended

* In a pamphlet by himself, Paris, 1844 (Fournier).

with frequent hæmorrhage. The patient may usually arrest this flow of blood by sucking ice, but this is likely to bring on fits of coughing. When such is the case, an ice-bag outside the neck may be tried, or a spray of tannic acid (grs. xx., ad ℥j.), applied through the mouth, as well as through the tracheal opening, if the bleeding takes place from ulcerated mucous membrane of the trachea: but as this hæmorrhage occurs at an advanced stage of the disease, the power to control it is very limited. If the laryngeal ulceration extends down the trachea, so that flaps of mucous membrane are formed, which constantly block up the end of the tube, they must, if possible, be removed, or the tracheal portion of the tube must be lengthened.

Case 1.—Mrs. S., aged fifty-one, a stout, fresh-coloured, healthy-looking woman, caught a severe cold during the winter of 1870. Her voice became very hoarse, and remained so until the spring of the following year, when it resumed its natural character. In the autumn the hoarseness returned, and two months after she experienced slight difficulty in breathing; but again in the spring improvement took place, the dyspnœa entirely subsiding, though slight hoarseness still continued. When I first saw her in September, there was great congestion of the vocal cords, with slight swelling of the ventricular bands, most marked on the left side, the right vocal cord being partially immobile; the right ary-epiglottic fold was also swollen. There was very slight difficulty in swallowing. The laryngeal condition gradually got worse through the winter; and on March 23, 1873, dyspnœa being urgent, I performed tracheotomy. The larynx at this time presented great thickening, and some ulceration of the left ventricular band, which covered the left vocal cord. The right cord was thickened, and completely immobile, due undoubtedly to the swollen condition of the arytenoid cartilage and the ary-epiglottic fold of the same side. There was also a small outgrowth on the inter-arytenoid fold. The patient progressed favourably after the operation, and was not seen regularly after April 18, though coming under observation occasionally during the year. On January 1, 1874, on visiting her, it was evident that disease of the cartilages had commenced. In the middle of April, finding she could swallow nothing, I fed her by the aid of an œsophageal catheter once a day, and nutritious enemata were administered morning and evening. She was kept alive in this way for three weeks, when it became evident on passing the catheter that there was ulceration from the œsophagus into the trachea; and consequently I was compelled to desist. The patient lived for five days longer, the enemata having been continued thrice daily.

Case 2.—G. H. G, aged fifty-two, a house painter, was laid up with some acute illness. Soon after leaving his bed he caught cold; and his

voice became hoarse. This was in March; but as the summer approached he improved, though never completely losing all the symptoms. During the winter months they always became aggravated. In 1869 he had a severe cold, nearly losing his voice altogether. His general health continued satisfactory. In January, 1873, the breathing became affected, and in April it could be heard even when the patient was quite quiet. He had difficulty in swallowing solid food. It was at this time that he came into the Hospital for Diseases of the Throat. On the 2nd of May I found it necessary to open his windpipe. There was great stenosis of the larynx, from swelling and ulceration of both ventricular bands and vocal cords, with œdema of the arytenoid cartilages and ary-epiglottic folds. In June it was noticed that perichondritis of the cartilages had set in, and deglutition became very difficult. On August 1, an abscess, which had formed in connection with the cricoid cartilage, broke internally; the patient was much relieved, being again able to take solid food. On the 29th he returned home to the north of England, and lived until November, 1874.

Case 3.—T. B., aged fifty-three, a public lecturer, was obliged in 1862 to desist from lecturing, on account of hoarseness. After abstaining for three years, he again resumed his occupation, though his voice was still hoarse. At the beginning of 1872 his breathing became difficult, and he lost his voice entirely. On July 30 I performed tracheotomy in this case, the breathing being exceedingly oppressed. The narrowing of the windpipe resulted from tumefaction of the whole of the laryngeal mucous membrane, with slight ulceration. Shortly afterwards the patient went to Manchester. When he was again seen on November 18, there was found to be displacement of the left arytenoid cartilage, and œdema of both ary-epiglottic folds and ventricular bands (the mucous membrane looked sodden, not presenting the clear, pearly look of acute œdema), showing that perichondritis of the laryngeal cartilages had been set up. He returned again to Manchester, with little chance of living longer than a month or so.

In this case, from the patient having been a total abstainer, there was great difficulty in prevailing upon him to take any stimulants; in fact, a prescription, containing "sp. vini gallici," had to be written out; and as in all probability he took none when not under direct supervision, the disease undoubtedly made quicker progress than would otherwise have happened.

B. 2.—*Syphilitic Laryngitis.* When there is recent thickening and ulceration of the mucous membrane, this condition bears some resemblance to chronic laryngitis, and also to laryngeal phthisis; and yet the three are generally unmistakable. Certainly cases come under observation which have arrived at such a

stage as that just mentioned, and the diagnosis cannot be made except by their histories. Syphilis has been in my practice the most frequent disease requiring tracheotomy, and chronic laryngitis the next. Out of thirty-eight cases in which I have operated, sixteen were for the former, and eleven for the latter disease.

Tracheotomy may be necessary for congestive thickening and ulceration of the vocal cords, ventricular bands, and arytenoid cartilages; thickening and distortion of the epiglottis; distortion of any part of the larynx; or for cicatricial contractions, or webs in the pharynx, larynx, or traehea.

When the morbid condition only amounts to congestion and thickening (Case 1), or thickening with ulceration of the vocal cord and ventricular band on one side, the prognosis with reference to being able to remove the tube at a future date is extremely favourable; possibly removal of the canula may be feasible after the first fortnight if constitutional treatment has been carried on.

When both sides are affected (Case 2), the prospect as regards the removal of the tube is, perhaps, equally good if the disease be recent; but it is to be expected that the time which must elapse before it can be removed must be longer. In these unilateral and bilateral conditions, when of recent date, tracheotomy may be at times avoided, although the dyspnœa is severe, if specific remedies are steadily employed, combined with benzoin inhalations every one or two hours, the patient being at the same time kept strictly at rest in bed.

When the epiglottis is bound down, or the larynx much distorted, the probability of doing away with the canula is almost nil, except in some few cases of distortion, where the thickening is capable of being absorbed by a long-continued use of iodide of potassium, or when it takes the form of a flap of mucous membrane (Case 3), acting as a valve to the glottis, and can be removed by the laryngeal forceps. Cicatricial webs in the pharynx (Case 4) and larynx (Case 5) can be destroyed by the galvanocautery, but the treatment in most cases has to be carried on for some time, owing to the many sittings required to destroy them, on account of their being so closely and thickly incorporated with the mucous membrane from which they are formed, and also because a system of dilatation has to be carried on for many

months after the destruction of the webs, in consequence of the liability of the ulcerated surfaces to contract during the process of healing. Patients should be taught how to carry on this dilatation themselves. Dr. Stoerk, of Vienna, employs laryngeal dilators, which are made of twelve different sizes in vulcanite, and hollowed throughout, so that respiration can be carried on while they are in the larynx, without the trachea having been previously opened. They can be used for an hour at a time. For cases in which tracheotomy has been performed, Dr. Schrotter, of the same town, has originated the plan of passing a leaden plummet into the larynx, where it is held in position by a peg on the upper part of the curve of the canula fitting into it. Patients have become so accustomed to the presence of these plummets, that they have worn them night and day, and have been able to pass them in themselves. Thyrotomy has also been resorted to in the treatment of laryngeal webs, but with indifferent success.

In some cases of syphilitic laryngitis tracheotomy may be avoided, although the degree of difficulty of respiration might seem to warrant its performance, and these are the cases in which it is judged after examination with the laryngoscope that with suitable treatment the laryngeal stenosis can be overcome before the necessity for operating is imperative. The treatment in such cases should be to keep the patient strictly at rest in bed, not even allowing talking; to push the employment of specific remedies; and to use benzoin inhalations every hour or two hours. Tracheotomy should, in my opinion, never be resorted to except for the purpose of relieving the breathing. It is the belief of some surgeons that by the performance of the operation before it is a necessity the disease may be cut short; some going still further, and affirming that the morbid changes often lead to permanent occlusion of the larynx, unless an operation has been carried out at an early period. To this statement I most emphatically object, for experience has proved it to me to be otherwise.

Case 1. *Congestion and thickening of the right side of the larynx.*—E. B., aged twenty-nine, a clerk's wife, affected with syphilis, suffered in

November 1872 from extreme dyspnœa and aphonia. There was seen to be great thickening and inflammation of the right ventricular band and right vocal cord. The patient's voice had become hoarse for the first time nine months previously, and her breathing had been embarrassed for three months. These symptoms increasing, I performed tracheotomy on the 16th of November. During the operation not more than a teaspoonful of blood was lost. This was an important consideration, for the patient was in a greatly debilitated condition, her pulse only beating forty times per minute. (A month after the operation it was very infrequent, ranging for some days from sixteen to twenty-four beats.*) The sterno-mastoid muscle of the right side was noticed to be larger and much harder than its fellow. She was treated with five grains of iodide of potassium thrice daily. On December 29 the tube was removed. An examination of her throat a month later showed that all thickening had disappeared, and that there only remained some slight congestion of the vocal cord. All swelling of the sterno-mastoid had disappeared. The patient is still periodically obliged to resume the iodide, to prevent the recurrence of the laryngitis.

Case 2. *Congestion and thickening with superficial ulceration of both sides of the larynx.*—John M., aged forty-five, contracted an infecting chancre in 1856. He had no throat affection until 1863, though he had previously had a syphilitic rash on the skin, which troubled him at different times. The affection of his throat lasted in 1863 for ten months. In December, 1873, it returned, and from that time he never lost the hoarseness which had been present from the commencement of this last illness; but difficulty of breathing came on during the autumn of 1874, and increased to such an extent, that he was taken into the Throat Hospital; and on November the 12th tracheotomy was performed. At that time the larynx presented thickening with congestion and ulceration of the vocal cords and ventricular bands. Specific treatment was carried on after the operation, and on the 12th of December, the stenosis being observed to have disappeared to a sufficient extent, the tube was removed. Three months after this date, the patient came to the hospital with extensive ulceration of the soft palate, having discontinued treatment for six weeks, but his larynx was much improved.

Case 3. *Distortion of the larynx, with a flap of mucous membrane acting as a valve to the glottis.*—G. K., aged thirty-six, was from 1863 to 1868 much subject to sore throat, with huskiness; from that time to 1873 he experienced difficulty of breathing. This difficulty gradually increased, and was accompanied during the latter part of the time with an inability to take solid food. In 1862 he had contracted a chancre. In May, 1873, he came to the Hospital for Diseases of the Throat, and at this time was

* Clin. Soc. Trans., vol. viii., p. 95.

suffering from constant stridulous breathing, with attacks of suffocative dyspnœa. On examination, the larynx presented great thickening of the ventricular bands and arytenoid cartilages, while the other structures were disorganized from previous ulceration. There was a small opening left in the larynx, covered with a flap of mucous membrane, which moved up and down with expiration and inspiration. On May the 18th my colleague, Dr Morell Mackenzie, removed a piece of the flap with the aid of the laryngeal forceps. Towards evening the patient's breathing became much worse, and on the following day I was requested to perform tracheotomy. On June 20 Dr. Mackenzie removed the remaining portion of the flap. During his stay in the hospital, the patient was treated with iodide of potassium. In July the opening in his larynx was noticed to be considerably larger ; but not until October was his breathing free enough to permit the removal of the tube. Since June he had been able to take solid food.

Case 4. *Web in pharynx.*—J. C., aged thirty, contracted syphilis in 1867. Twelve months afterwards his throat became ulcerated, and very sore in swallowing. It never improved ; and in September, 1873, when he came to the Throat Hospital, his breathing was markedly stridulous, and he could only feed himself with a spoonful of fluid at a time, and that would often regurgitate up through the nostrils. He said that for six months his breathing and swallowing had been difficult. On looking into his throat, at the back of the tongue, nothing except a cicatricial membrane was seen, with a narrow slit in its upper part, which was found to communicate only with the posterior nares. This membrane dipped in a funnel-shape towards the epiglottis. Though air could be seen bubbling up from below, no opening could be discovered until after a long examination, when I managed to pass a probe in, not larger than an ordinary pin's head. The wonder was how the man could manage to live, respiration and deglutition both having to be carried on through this opening. On the afternoon of his admission I performed tracheotomy, and on the following day commenced dilating the stricture with œsophageal bougies. At the end of a month No. 19 could be passed with difficulty. Finding that no further dilatation could be expected, the galvanocautery was used. A week afterwards the patient took solid food, and has done so ever since. He still wears the tube, but with the inner one corked, except whilst eating. Three times a day he is in the habit of passing a large pewter sound through the opening, and in each month for a week he takes ten grains of iodide of potassium once a day. It is purposed, when he can spare the time to come again into the hospital, to destroy the remaining portion of the web, and then to remove the tube.

Case 5. *Web in larynx.*—Mrs. P., aged thirty-one, noticed that her breathing became affected in March, 1874. For three years previously she had lost her voice. In August it was found necessary to perform tracheotomy. On examination of the larynx, a web was seen covering

the whole of the glottis, leaving a very minute opening under the inter-arytenoid fold, and this was not visible unless the patient made a very deep inspiration (*vide* Fig. 14). Since the operation she has taken iodide of potassium regularly; and when the tube is blocked, her breath-

FIG. 14.—Syphilitic web in Larynx.

ing has very much less stridor, while her voice is good. It is intended at some future time to destroy the web in the median line by galvano-cautery. This will have to be done very carefully, as the exact relation of the vocal cords to the web cannot be determined.

B. 3.—*Laryngeal Phthisis.* In this condition tracheotomy is to be avoided as a rule; nevertheless in some few cases it may seem our duty to recommend its performance.

Where the patient has a fair amount of bodily vigour, the lung-disease not being far advanced, provided the difficulty of breathing demands it, the operation may justly be had recourse to. This would seem to be especially the case should the dyspnœa arise from œdema of the arytenoid cartilages, which is now known to be a symptom of phthisis, discoverable sometimes before there is any evidence of the breaking-up of lung tissue, or of pulmonary consolidation. Should there be œdema of the epiglottis at the same time, the dyspnœa will come on with greater rapidity. If the early œdema of phthisis is such as to cause much trouble in respiration, sufficient relief may usually be obtained by scarification.

Simple warty growths in the larynx are sometimes followed by, or perhaps may be called precursors of, phthisis, as in the following case:—

Case 1. *Growths in the larynx.*—J. C. B. D, aged seventeen, a clerk, began to lose his voice in the spring of 1871; though at times improving very much, he never completely regained it. In the winter his breathing became affected, and in March, 1872, he was obliged to give up his situation. At this time he came into the Throat Hospital. His larynx then was

much encroached upon by warty growths. These were, to a great extent, removed by means of laryngeal forceps; but towards the end of the month they grew rapidly, so as to cause much dyspnœa, and I was called in to perform tracheotomy. The whole condition of the boy altered shortly after the operation. He lost flesh rapidly, had a high temperature, and perspired profusely at night. Moist crepitant râles were heard over the greater part of the right back. It had been doubtful when he was first seen whether he was phthisical; owing to the noisy respiration, his chest could not be properly examined. There was a family history of consumption. He died on the 19th of June; no *post-mortem* was allowed.

B. 4.—*Carcinoma Laryngis.* The rule to be followed in advocating tracheotomy in this disease is as follows:—If the morbid condition causes little or no difficulty in swallowing, but only dyspnœa, the operation is to be decidedly recommended (Case 1); but cases are seldom met with in which these two symptoms are not combined, which can be explained by the fact that, with very few exceptions, cancer attacks the larynx externally, appearing first in the outer surface of the arytenoid cartilages or the ary-epiglottic folds, and thus encroaches upon the orifice of the œsophagus as well as the laryngeal canal. There is generally a great alteration in the relation of the parts, with an asymmetrical appearance of the larynx. The affected part is commonly surmounted by two or three white adherent patches, which are surrounded by a very inflamed areola. These white spots, when present, have much the appearance of diphtheritic membrane. Rapidly-growing vegetations in the larynx, necessitating tracheotomy, may turn out to be of a cancerous nature. This was the case in a patient upon whom I performed thyrotomy in 1872.* Tracheotomy in carcinoma may be desirable for family reasons, as in the case of an aged clergyman operated upon by Mr. Cooper Forster.† He was eighty years of age, and lived three months after the operation.

Billroth has in two cases of cancer extirpated the entire portion of the diseased larynx, and cleverly substituted a mechanical vocal apparatus, by which the patient in one case was able to

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* Clin. Soc. Trans., vol. vi., p. 90.

† *Brit. Med. Journ.*, March 27, 1871.

speak with a fairly good voice, though gruff, and lived for eight months after the operation. In the second case the patient died shortly after the excision. Haine of Prague, and Moriz Schmidt of Frankfort-on-the-Maine, have also extirpated the larynx. Chronic laryngitis appears to be the most favourable disease in which this plan of treatment might be tried.

Cancer may attack the walls of the trachea. It may be judged desirable in such a case to perform tracheotomy, especially if the carcinomatous growth forms in the upper part of the trachea, and the swallowing is not affected. This happened in the case of a lady upon whom I operated in 1873, the cancer invading the upper and anterior wall of the windpipe.

Case 1. *Carcinoma of the interior of the larynx on the right side.*—Matilda McS., aged fifty-nine, a nurse, complained of slight hoarseness in the beginning of June, 1875. About the middle of July her breathing became affected, and during the next month she completely lost her voice. Her respiratory trouble also steadily increased, so that after the first week in September she was always obliged to sit up in bed. At no time did she experience any difficulty in swallowing. When admitted into the Hospital for Diseases of the Throat in September, it was seen that the right ventricular band was attacked with cancer, so that it covered over the right vocal cord, and greatly encroached on the laryngeal canal; and as the dyspnœa was very great, I opened her windpipe without delay. She did well after the operation, the only trouble in her case being that granulations formed around the wound, and caused some difficulty on the re-introduction of the tube after its daily removal; but these were completely reduced before her discharge on November 24. Her power then of deglutition still remained intact, although the carcinomatous swelling had involved the right ary-epiglottic fold.

B. 5.—*Non-malignant growths.* Neoplasms situated in the larynx, when they have attained some size, necessitate tracheotomy. These growths may either spring from one vocal cord, or from both, or they may grow out from the ventricles, and from other parts of the larynx. It is unsafe to attempt their removal with laryngeal forceps when there is much dyspnœa, should they spring from more than one root; but though the dyspnœa be urgent, if there be only a single large pedunculated polyp, this may be removed, care being taken that the instruments for tracheotomy are at hand. Occasionally it happens, after the partial removal of laryngeal growths, that the remaining portion

is displaced, or inflammation is set up in it and the neighbouring tissues, causing them to swell, and the increased obstruction thus induced may necessitate tracheotomy.

The prognosis regarding the permanent removal with the tube is favourable, although after tracheotomy growths are not always so easily removed through the mouth, and sometimes thyrotomy is the only means of extirpating them. In young children the recurrence of the neoplasms after thyrotomy, with the return of obstructed laryngeal symptoms, calls for tracheotomy, and not a repetition of thyrotomy, but it is requisite to wait until the child arrives at a sufficiently advanced age to co-operate in the attempt to remove the growths by means of laryngeal forceps introduced through the mouth. A case of this kind under my care at the present time is given below.

Case 1.—A. G., between five and six years old, is a boy on whom in the summer of 1872 I performed thyrotomy, for the removal of warty growths, which blocked up his larynx.* Six months after, the growths having recurred, and his breathing being again much impeded, tracheotomy had to be done. It was not considered advisable to subject him to a repetition of thyrotomy, but to wait until he was old enough for an attempt to be made to remove the growths with forceps through the mouth. It is necessary every now and then—sometimes in two months, at other times not for many months—to clear the tracheal openings of the growths which have extended down to it. The boy keeps in fairly good health, and is able to play about with other children.

C. Neuroses of the Larynx.

1. *Paralysis of the abductors of the vocal cords* occurs from pressure on the recurrent laryngeal nerves by an aneurism, cancer of the œsophagus, by some intrathoracic tumour, by enlarged bronchial, cervical, or thyroid glands; or from cerebral disease implicating the pneumogastric nerve.

The vocal cords in paralysis of the abductors lie parallel in the middle line of the larynx, with only a very small chink between them; and there is total, or almost total, inability on the part of the patient to separate them. As a rule they are more or less congested. The breathing is markedly and continuously stridulous, being worse during sleep. The patient will

* Clin. Soc. Trans., vol. vi., p. 92.

tell you that he is awakened after he has been asleep for a short time by a feeling of suffocation; this is owing to what little remaining power of abduction of the vocal cords there has been becoming *nil,* voluntary effort being absent during sleep.

The only remedy for such a condition is tracheotomy; but if there is extreme dysphagia, arising from the same cause of pressure as the laryngeal disturbance, it is better to refrain from operating. Tracheotomy is admissible where the paralysis originates in some cerebral lesion.

Dr. Bristowe published a paper in the St. Thomas's Hospital Reports * on "The relative effects of pressure on the trachea, and pressure on the recurrent nerve, in producing impairment of voice and dyspnœa," and points out that there is severe continued dyspnœa in cases of the latter class, the paroxysmal attacks occurring where there is direct pressure on the trachea; and that when the dyspnœa is due to pressure on the recurrent nerves tracheotomy is justifiable, but not when the stenosis is tracheal, and is caused by the pressure of an intrathoracic tumour, especially if an aneurism, as Dr. Gairdner has advocated. The cases in which there is an actual certainty that a sufficient space is left to insert the tube below the seat of obstruction are extremely rare, and certainly are never met with when the cause of pressure is aneurismal.

In 1869 I was acquainted with a case in which paralysis of the vocal cords arose from the mechanical action of some non-malignant growths, situated directly below the vocal cords. These were gradually removed after tracheotomy, and five months later the tube was taken away, the action of the vocal cords having apparently been restored, and the breathing being normal.

Dr. Mackenzie, in his work on "Hoarseness and Loss of Voice,"† records a very typical instance of paralysis of the abductors. An American judge came under his care in September, 1866. He had experienced in 1851, after delivering a

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* Vol. iii., N.S., 1872, p. 206.

† 2nd ed., p. 31.

charge of several hours' duration, a sudden and extreme spasm of the throat, and since that time he had occasionally suffered from similar but milder attacks of the same sort. For the seven or eight years previous to consulting Dr. Mackenzie his voice had become weak, and a short time before, on the least exertion, he made a great noise in his breathing. This was the case also during sleep, disturbing people in the adjoining rooms. On examination the vocal cords were found to be scarcely abducted from the median line during inspiration, the space between them being not more than $\frac{1}{16}$ of an inch. On forced expiration they moved about double that distance. They were of a natural colour. Tracheotomy was strongly recommended, but the patient would not consent, though on going to the Continent he took with him a case of tracheotomy instruments.

FIGS. 15 and 16. Bilateral paralysis of the abductors of the vocal cords. A. Inspiration. B. Forced expiration.

The operation had to be resorted to later in the year at Geneva, The patient was seen in October, 1867, when his general condition was found to be greatly improved. Dr. Mackenzie was of opinion "that the paralysis of the abductors was due to simple atrophy of the muscles, uncomplicated by any nerve affection, but it may have been caused by peripheral disease of the brain, involving the origin of the pneumogastric or spinal accessory nerves."

2. *Spasm of the adductors of the vocal cords.* Not in this as in the former neurotic condition are the vocal cords incapable of being separated, for they are at one moment violently abducted, and the next as violently brought together again, the process rapidly recurring for hours together, perhaps with no intermission. In children the dyspnœa is accompanied with a

crowing, croupy noise, but in adults there is usually a constant short cough, occurring every few seconds, except when the patient talks. It is a common disease in children under two years of age, being the affection known as Laryngismus Stridulus or False Croup. The cause may be cerebral or reflex, in connection with some unhealthy condition of the system, as from diarrhœa, teething, or worms. It is said that direct pressure on the recurrent nerves may cause it. Fluids or irritating vapours passing into the larynx will produce the same effect. Spasm of the adductors occurs also in hysteria. The remedies to be first tried are emetics, shower baths, and especially inhalations of chloroform; should these prove unsuccessful, tracheotomy must be performed. Tracheotomy may have to be done on children as well as adults. In laryngismus stridulus, the good old plan of putting the child into a hot bath and dashing cold water into the face, thus overcoming the spasm of the vocal cords by giving rise to deep inspirations, must not be forgotten. The only case of spasm of the adductors of the vocal cords which has come under my notice requiring tracheotomy was that of a young woman, for whom every remedy to relieve the severe stridor had been previously tried. She had the rapidly repeated cough mentioned above. When she was last heard of she had entered the Hospital for Incurables, being quite unable to do without the canula.*

In the early part of 1873, at Vienna, a laryngeal tumour, which sprang from the cricoid cartilage, was being injected with perchloride of iron, a few drops of which unfortunately escaped into the trachea; this caused such spasm of the glottis that, in spite of tracheotomy having been quickly performed, the patient died.

D. Traumatic Conditions.

1. *Scalds of the Larynx.* This accident happens chiefly amongst children of the lower classes, who from being allowed to drink out of the spout of the teapot, when left alone go through the same process with the kettle. Œdema of the

* This case was seen in the early part of 1876. The woman was found to be still unable to do without her tube. It had then been in between eight and nine years.

epiglottis, as well as commonly of other parts of the larynx, rapidly follows, and in many cases if tracheotomy is not quickly performed suffocation ensues, though if possible the operation should be avoided, even supposing the child to be *in extremis*, and it may be so avoided by scarifying the epiglottis, which can be readily seen on depressing the tongue. Emetics are advised, so that the straining efforts of the child during vomiting may cause the tensely swollen mucous membrane to burst and let out the fluid. Leeches are also applied to the throat externally. A grain to two grains of calomel every half hour or hour has been strongly recommended, with or without tartrate of antimony (gr. $\frac{1}{10}$—$1\frac{1}{2}$), until green stools are produced. For my own part I place much more reliance upon free scarification than upon any other method of treatment.

The prognosis is frequently unfavourable, owing to the passage of the boiling water down the trachea into the bronchi, as well as down the œsophagus, which causes serious mischief, and sets up severe constitutional disturbance.

Out of fourteen cases in which tracheotomy was performed, collected in the *Medical Times and Gazette*, Dec. 8, 1859, eleven died. The ages of the patients ranged from one year to five, showing that before twelve months old children are too young, and over five too sensible to drink out of a kettle.

2. *Swallowing corrosive poisons* may lead to lesions which necessitate tracheotomy, and as in the case of the contretemps just considered the prognosis is unfavourable, owing to the charring and destructive effects of the poison, not only upon the pharynx and orifice of the larynx, but also upon the œsophagus, stomach, and perhaps duodenum, accompanied by great constitutional disturbance.

3. *Poisonous bites of Insects.* When the stings of certain insects are about the head and neck grave results may ensue, and if the usual remedies for the relief of œdema of the larynx fail, tracheotomy will be necessary. The effects produced by a poisonous bite are very rapid. In the summer of 1874 the son of a friend of mine was stung in the face by a wasp, and before two or three minutes had elapsed he was struggling for breath. No medical assistance being at hand, water as hot as could be borne was

applied to the neck; the urgent symptoms were not relieved for many minutes. The following case was related to me as having happened some years ago. A gentleman was eating a peach, when a wasp which had got inside it stung him in the mouth, and he was shortly afterwards seized with suffocative dyspnœa, so that tracheotomy had to be performed. Prognosis in these rare cases is favourable.

4. *Cut-throats.* Some cases of incised wounds may at the outset require the insertion of a tracheal canula; in course of time, also, should the mucous membrane have become united along the incision so as to form a web across the windpipe, tracheotomy may be necessary. A cicatricial web formed in this manner is as difficult to eradicate, if it is wedge-shaped (as it is nearly sure to be), as when originating in syphilitic cicatrisation. The treatment recommended on page 47 should be carried out. The following case shows the liability of webs to form again after their destruction.

G. E. W., aged 36, a farrier, one day in 1872, when drunk, cut his throat. He was taken to the Kingston Infirmary, and at the end of a month was discharged, his breathing being normal. Before another month had passed he was suffering from extreme difficulty of breathing, and was obliged to undergo tracheotomy. In June 1873 he came under my notice, and laryngoscopic examination revealed a web passing across the larynx, immediately below the vocal cords, which were somewhat amalgamated with it. The opening through this web was about the size of a carpet-pin's head. A scar extended from the left to the right carotid region, running about half-an-inch below the Pomum Adami. On placing a finger over the tracheotomy-tube the breathing immediately became laboured. The patient experienced no difficulty in swallowing, On July the 4th I performed thyrotomy, and dissected away the web. In doing so I had to remove the right vocal cord, which was inseparably connected with it. After this he did without the tube, and returned to his work until the following November, when his breathing again became as bad as before, and tracheotomy had to be done. At the same time I destroyed the web with the galvano-cautery, passing the electrode up through the tracheal opening. The tube was kept in afterwards, but with the inner canula corked up. Sounds were passed up daily into the larynx. After six weeks of this treatment the patient was for some time lost sight of, and when again seen the web had formed anew. Nothing has since been done, but it is proposed to have the patient for some months under supervision in order steadily to keep up dilatation after the

use of galvano-cautery. The opening in the larynx at the present time is represented by a narrow antero-posterior slit. The voice is gruff, but fairly strong. The new cicatricial tissue of the web seems to supply the place of the right vocal cord, and exhibits the condition shown in the woodcut (Fig. 17), except that in this it presents too regular an appearance.

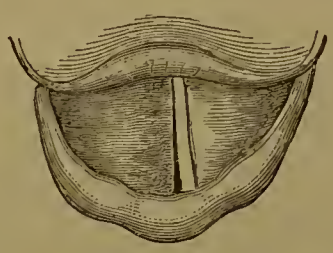

FIG. 17.—Cicatricial web in larynx.

The photographed specimen (Photo. III.) of cut-throat was taken from a woman whose trachea was completely divided at the third ring. On the tenth day after the injury she was nearly asphyxiated, and a canula had to be inserted. She lived for a year. No destruction of the web had been attempted.

The web will be seen not to be a simple layer of mucous membrane, but a thick wedge-shaped union of the whole of the tissues, and this will explain the difficulty there would be in first destroying it, and afterwards keeping the ulcerated sides of the canal from re-uniting.

6. *Foreign bodies.* It is of rare occurrence for foreign bodies to become impacted in the larynx or trachea so as to necessitate the performance of tracheotomy. Amongst those cases which have come under my notice was one in which a French plum stone lodged obliquely in the trachea, directly under the vocal cords; and a second in which a safety pin had been swallowed by a child of three years old, and drawn into the larynx. These two cases are reported below.

A curious case of a foreign body in the larynx has been narrated to me as having happened in Madras in the summer of 1873. The facts are these:—Native fishermen there have a practice of holding in their mouths the fish which they have last caught while they bait their hooks afresh. One of them was doing so when the fish jumped down his throat, and stuck there. The bystanders could not withdraw it on account of

PHOTO. III.—Illustrating Cicatricial Union of Mucous Membrane at Junction of the Larynx and Trachea following Incision of Throat.

e, Epiglottis.
v.c, Vocal cords.
c.w, Cicatricial web.
o, Opening for tube.
u, Ulceration of mucous membrane from pressure of tube.

the prickles on its back, and as no medical man was near to open his windpipe the man was suffocated.

The rule should be that unless the foreign body can be removed safely through the mouth, without fear of its slipping further down, there should be no delay in performing tracheotomy, even if the respiration is not seriously affected. There is but little hope that by waiting the substance will be coughed out. The plan of inverting the body, so successful in Brunel's case, is to be regarded as a dangerous measure, because the foreign body, as, for instance, a coin, might get changed from a perpendicular to a transverse or horizontal position, so that the patient would then very quickly become suffocated. By making the cut through the tracheal rings of more than ordinary length, sufficient room would be obtained, if the foreign body is situated below the incision, for it to be coughed up. The blunt-pointed hooks come in very usefully in these cases for widely stretching open the trachea. If the foreign body be impacted in the larynx, it may be thought more advisable to push it out of the larynx by means of a curved probe passed through the tracheal opening, rather than to attempt to remove it by forceps introduced through the wound. By putting in a fenestrated canula in the former method, and passing the probe up through it, there is less risk of the foreign substance falling down the trachea, if the attempt to push it into the pharynx should fail.

As a rule the usual fit of coughing which ensues directly upon opening the trachea expels the foreign body. Should this not happen, and it cannot be pushed into the mouth, thyrotomy must be performed without delay. If the body be firmly lodged low down in the trachea, or in either bronchus (usually the right bronchus, as this lies in a more direct line with the trachea than the left), irritating the trachea with a feather, and thus making the patient cough violently, will often cause it to be ejected through the tracheal wound, this being held widely open by the retractors. Should this plan fail, a long pair of right-angled forceps passed through the opening in the trachea will sometimes enable the operator to get hold of the substance. If none of the measures for extracting the foreign body succeed,

the circumstances of the case must guide in the subsequent management. It is rare that it is ejected after a lapse of time, though fortunately this has occasionally happened, even after it has caused an abscess where it had been lodged. Perhaps it will be advisable to have the trachea held open for some hours, especially if there seems to be any hope of the patient eventually coughing the foreign body up. The most likely course of events to make this plan desirable, is when the foreign body gets dislodged occasionally from its position, but it is impossible to seize upon it, and it falls back into its former position. If it be decided to put in a tracheal canula, very rigid supervision of the patient must be carried out, so that the tube may be withdrawn immediately should there be any dislodgment of the foreign body. The stools of the patient should be carefully examined, in the event of the substance being coughed into

FIG. 18.

the mouth without the cognizance of the patient, and swallowed, being of such a nature that it will pass unaffected through the bowels. This happened in the second of the following cases:—

Case 1, *Plumstone in trachea.*—Harriet D. had a fit of coughing, whilst eating a French plum, and she felt the stone go down the "wrong way." Difficulty of breathing, accompanied by a pricking sensation, immediately ensued. During the following day she was unable to take solid food. The respiration continued embarrassed, and throughout the night she had to be propped up in bed. Fifty hours after the accident I performed tracheotomy, as it was considered unsafe to attempt to remove the stone, which was seen below the vocal cords, lying obliquely in the trachea (see Fig. 18). In the event of the forceps not grasping it on the first attempt, it would have been nearly certain to pass lower down the trachea, very likely into one of the bronchi. On opening the windpipe, a violent expiration took place, and the stone was ejected through the mouth. The wound was closed up, and the patient, as she was in the

seventh month of pregnancy, discharged from the Throat Hospital on the 10th of February, 1873, four days after the operation. If the stone had not been coughed up, it was intended to push it up out of the larynx by the aid of a curved probe, passed through a fenestrated canula.

Case 2. *Safety dress-pin in larynx.*—In April 1874 I operated on a clergyman's child, about three years old, who had swallowed a safety dress-pin. When the trachea was opened, the foreign body could be felt fixed in the larynx. It was dislodged during the examination, but not coughed up through the mouth ; nevertheless, as it could no longer be felt in the larynx, and had not passed the trachea, it was certain it must have passed down the œsophagus. Under these circumstances, a tube was left in the trachea, and directions given to carefully examine the excreta. Within the next twenty-four hours the pin was thus found, and accordingly the tube removed.

D. 7. *Rupture of the trachea.* This may result from external injury, or in connection with diseases causing forcible respiratory efforts. Tracheotomy is necessary, usually on account of the subcutaneous emphysema which follows the accident. The laceration may be very extensive or very minute, and may take place between the cricoid cartilage and the first ring of the trachea, or between any of the rings of the latter. If very extensive, there may be fracture of the rings as well.

Mr. Long,* of Liverpool, has recorded a very interesting case, which was successfully treated, although the laceration was of great extent. A railway labourer, caught round the neck by a coupling chain, had his trachea torn across at about the second ring, the separated portions being found to be two inches apart. A tracheotomy tube was worn for five months, when it was supposed that the space had filled up by a narrow fibrous tube, without cartilaginous rings. It was remarkable that emphysema was almost entirely absent after the accident, air being prevented from getting into the tissues by layers of coagulated blood. When the man was seen ten years after the accident,† he was in good health and able to work, and had a natural voice. There was no appearance of a fibrous tube, but "when he expired, the integuments between the sterno-cleidi muscles

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* *Med. Times*, July 26, 1856.

† Liverpool Med. and Surg. Reports, Oct., 1867, p. 12.

were thrown out, so as to form an all but plane surface between them; when he inspired, they sank down, forming a complete gutter from the larynx to the sternum. The spine could be felt on pressure, but no defined lateral boundaries could be detected." Voss records two cases of rupture of the trachea occurring in croup.* In one the injury happened in the case of a child of two and a half years, between the first and second cartilages. Death followed in six hours, tracheotomy having been refused (Latour). The other occurred in the practice of Dr. Gerscheidt, who "arrested the alarming and rapid progress of emphysema" by tracheotomy.

5. *Injuries to the laryngeal or tracheal cartilages* may result from the throat being violently compressed, as in garotting, or from a blow; or from gunshot wounds. The injury may be a dislocation or a fracture—more commonly the latter. Dr. Cohen† affirms that the thyroid cartilage is most liable to be fractured, the cricoid coming next in frequency; but in many cases they both get broken. The hyoid bone, he states, is seldom injured. The arytenoid cartilages, from their mobility, are more apt to become dislocated. Fractures of the tracheal cartilages may also occur.

The symptoms which follow the injury, according to Hunt,‡ are dyspnœa, orthopnœa, and emphysema, with consequent distress, anxiety, and lividity of countenance. There may be pain and cough, with difficulty in deglutition. These symptoms, with bloody expectoration, and crepitation on manipulation of the cartilages, are diagnostic. There may be an external deformity from over-riding of the broken portions of the cartilage. Cohen remarks,§ in speaking of the diagnostic value of the crepitation, that "care must be taken not to mistake for this the crepitation which can be performed in the normal larynx by lateral movements, or by slight pressure against the vertebræ."

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* *New York Med. Journ.*, Jan., 1860, p. 37

† "Diseases of the Throat," p. 487.

‡ *Amer. J. Med. Sci.*, April, 1866, p. 378.

§ *Ob. cit.*, p. 489.

Tracheotomy is required in very many cases,* but in those cases in which it is not thought necessary, constant watching of the patient must be exercised, on account of the liability of a broken portion of a cartilage to become displaced by the slightest movement on the part of the patient; thus, blocking up the windpipe, may quickly suffocate the patient. It is best, as far as possible, to immovably fix the patient's head by means of bandages until union of the cartilage has taken place.

Tracheotomy in Miscellaneous Diseases.

Tracheotomy has been recommended and performed in the following diseases and accidents :—

Goitre, Lymphadenoma, Retro-pharyngeal Abscess, Tonsillitis, Epilepsy, Apoplexy, Tetanus, Hydrophobia, Drowning, Hanging, and Suffocation from Inspiring Noxious Gases.

Rarely is the operation necessary for *goitre,* which is fortunate; for it is a serious matter to have to open a trachea covered by an enlarged thyroid gland. It is more commonly in the *fibrous* variety than in the *cystic* that the breathing is seriously affected. Children and young persons of both sexes, up to the age of eighteen or so, when they have the thyroid gland enlarged, are often subject to a slight stridor in respiration, but the dyspnœa rarely becomes of serious importance. The fibrous goitre is not necessarily hard and tense, but more often is of a tolerably soft character, especially in young people. There are two conditions which lead to obstruction of the breathing—one, the easy compressibility of the trachea by the goitre, in consequence of the non-resistance of the cartilages in young people; the other, the growth of the enlarged gland between the œsophagus and the trachea, thus in time embracing the latter, and pressing on it, more especially in its non-cartilaginous portion. At times slight paralysis of one or both of the vocal cords is noticed, due to pressure on the recurrent nerve or nerves by the gland. Suffocative fibrous goitre in young people is very amen-

* For "gunshot wounds," see some interesting cases in the Med. and Surg. History of the War of the American Rebellion (1861-65), Part I Surg. Vol, p. 406.

able to treatment, which consists chiefly of weekly injections of the compound tincture of iodine (♏xv.—xxx.), after Leuke, of Berne's, method; the internal administration of iodide of potassium in small doses, with or without cod liver oil, sometimes assists.

I have met with one death as the result of suffocation from an enlarged thyroid gland; and probably in this case the boy, aged sixteen, was suffocated more by the position in which he fell, the circumstances being as follows:—He had been suffering for some time from stridor in his breathing, and was an out-patient at the Throat Hospital, having weekly injections of iodine, and taking iodide of potassium internally. For two nights before his death it appeared that his respiration had become much worse, and the second night he did not go to bed, preferring to sit up in a chair. Early in the morning he was heard to go downstairs, and shortly afterwards a fall was heard. He was found with his head doubled under a stair, and his feet against the hall wall. On being removed, he gave one gasp, and no more. It was judged that he was returning to go upstairs. and whether he stumbled and fell, or whether he fell in an attack of suffocative dyspnœa, could not be ascertained, but probably the former was the case; in consequence of the position into which he fell, his chin being pressed against his chest, with the already oppressed condition of breathing, he was unable to recover himself. At the *post-mortem* examination the thyroid gland was found enlarged, of a fibrous nature, but softish. It completely embraced the trachea, passing between it and the œsophagus.

Cystic goitre, from the free scope which it has to project externally, even when it has attained an immense size, rarely affects the respiration seriously. The plan introduced by Morell Mackenzie of converting it into a chronic abscess by one or two injections of a solution of iron (ʒij ad ℥j) is so infallibly successful, that it ought invariably to prevent the necessity of performing tracheotomy.

Should tracheotomy become necessary for an enlarged thyroid gland either of the cystic or fibrous variety, and there is no free space to open the trachea below it, the gland will have to

be removed, or, if possible, sufficiently dissected up to admit of the insertion of a canula. The six rules for the removal of the gland brought forward by Dr. Heron Watson, of Edinburgh, at the meeting of the British Medical Association last year (1875), well deserve attention. "1. The external incision should extend from the larynx to the sternum, if the tumour be large and spread widely in a lateral direction. 2. The vessels, arteries, and veins, should be secured as they are divided. 3. The fascia should be opened as widely as the skin, and, if the tumour be large, the soft parts may be divided transversely as far as the sterno-mastoid muscles. 4. The delicate investing fascial sheath of the thyroid body should be left undivided until the vessels included in it have been tied. 5. After the mediate ligature of the thyroidal vessels in the cellular sheath, the capsule of the thyroid gland should be opened by stretching through it in the middle line, and the attachments of the goitre carefully divided by blunt-pointed scissors curved on the flat. There should be no tearing away of the gland. 6. If bleeding occur after the separation of the tumour from any of its vascular attachments, the vessels, if they are to be secured, should be tied *en masse* along with the cellular sheath." Possibly the eeraseur * or the galvano-cautery might be found to be of service in an operation of this description.

Trousseau† operated once for dyspnœa caused by lymphadenomatous glands pressing on the trachea. For my own part if ever asked to operate in such a case, I should refuse, considering that the disease, having extended so far as to press on the windpipe, must, even if relief can be given to the respiration at all, before long prove fatal, and knowing that very probably the operation might turn out a failure in consequence of the extensive compression by the glandular mass.

For retro-pharyngeal abscess tracheotomy has been resorted to, as well as in tonsillitis.‡

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* Trousseau's Clin. Med. Syd. Soc., vol. i., p. 590.

† *Op. cit*, vol. v., p. 188.

‡ *Med. Times and Gaz.*, vol. xl., p. 359, and *Amer. Jour. Med. Sci.*, April, 1872, p. 404.

In the former disease it might possibly be necessary to open the windpipe, especially if the patient is an infant, and the abscess is very extensive; but for tonsillitis it should never be required.

Tracheotomy was recommended by Marshall Hall* for epilepsy, apoplexy, tetanus, and hydrophobia.† He stated at a lecture delivered at the Pennsylvanian Hospital in 1853 that in all these cases "its efficiency is at once rational, pointed, and indubitable. Fail it cannot." Pirrie‡ speaks of the operation having been done for all cases of suspended animation, whether from drowning, hanging, or inspiring noxious gases.

Dr. Wynn Williams § has reported two cases upon which he had recourse to tracheotomy in 1855, for the relief of epileptic seizures, as suggested by Marshall Hall. The first patient was a man who had had epileptic attacks for eighteen years, ever since he was ten years old. He had them day and night, and though every kind of treatment had been tried they were increasing in frequency. After the operation the fits gradually became less frequent and severe, and in a short time disappeared for weeks together. At the end of six months they began to return. He was a very intemperate man.

The second patient, aged 25, had for many years been afflicted with epileptic fits at night, but only for two years before the operation had they occurred during the day. After tracheotomy they ceased during the day, and he very seldom had one during the night. Two years after the operation he was seen, and expressed himself as never wishing to do without the tube.

The performance of tracheotomy in any of the diseases recommended by Marshall Hall cannot, I think, fall in with the views of modern surgery, and I have never met with a case of either of these affections requiring such treatment, nor can I conceive that it could prove of any service, unless it be in a few extremely exceptional instances.

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* *Amer. Jour. Med. Sci.*, vol. xxvi., p. 55.

† See also Trousseau's Clin. Med. Syd. Soc., vol i., p. 711.

‡ Surgery, 3rd ed., p. 943.

§ *Med. Times and Gaz.*, Sep. 15, 1860, p. 253.

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